THE AEROPLANE and ASTRONAUTICS

JULY 8, 1960

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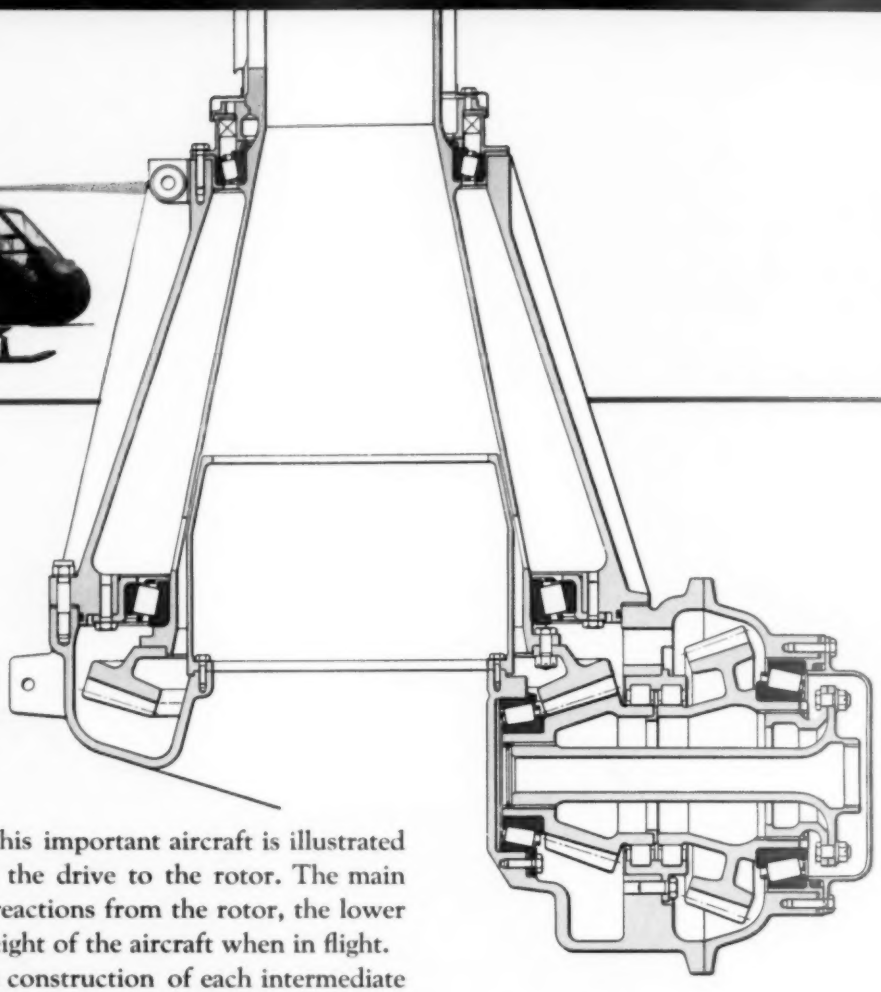


ON THE SAUNDERS-ROE

'WASP'

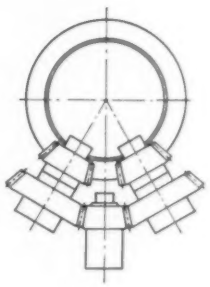
THE secondary gearbox of this important aircraft is illustrated in the drawings, and takes the drive to the rotor. The main rotor bearings take all the reactions from the rotor, the lower bearing sustaining the whole weight of the aircraft when in flight.

An interesting feature is the construction of each intermediate shaft: the two bevels are coupled by a splined 'quill' with a flanged connection; this construction provides a fine vernier adjustment to time the bevels in load-sharing relationship, and in addition provides some torsional elasticity and accommodates any minute radial misalignment.

Each assembly is supported at mid-length by parallel-roller bearings running directly on the bevel gear bosses. Fine axial adjustment of bevels and pre-load of the Timken bearings is effected by shims behind the flange of the small bearing and the end cover: there is also, between the bevel bosses, a selected washer which transmits the pre-load.

The Wasp embodies 42 Timken bearings, including those in the tail-rotor gearbox and the rotor-blade flapping and drag hinges.

British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Brazil, Canada, France and U.S.A.



As is shown in the above diagram, a bevel gear on the input shaft meshes with a larger bevel on each of two intermediate shafts; these in turn have smaller bevel gears meshing with the crown wheel on the rotor shaft, giving an overall reduction. In this way the drive is taken off the input bevel at two places, and received by the crown wheel at two places.

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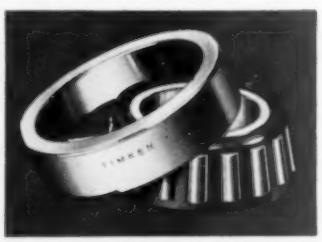

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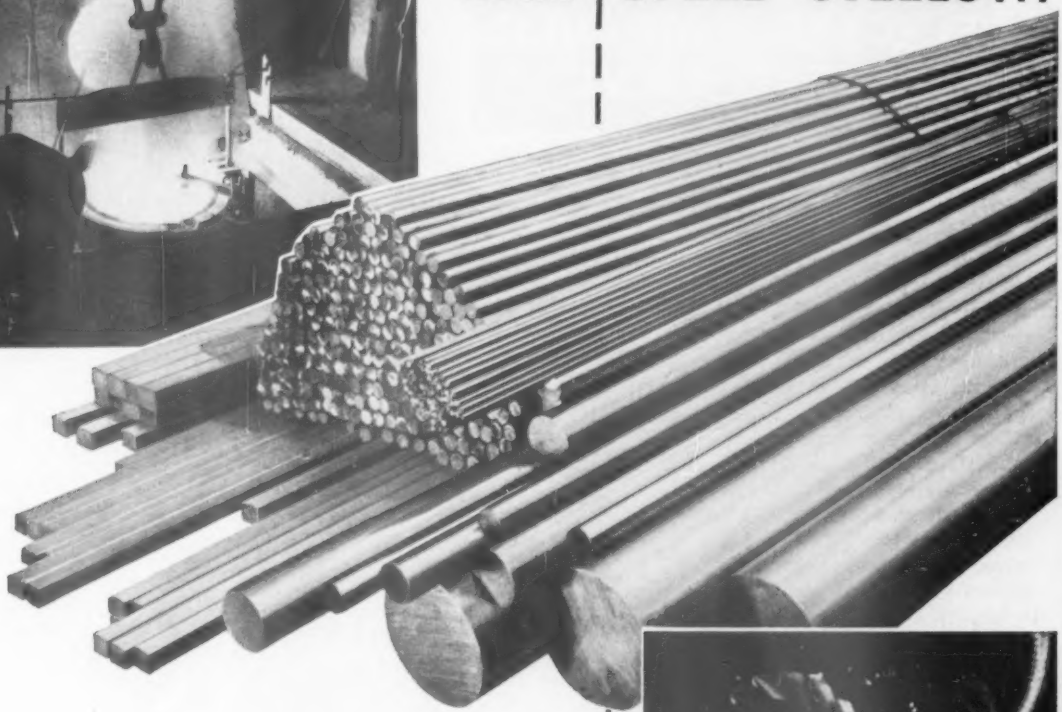

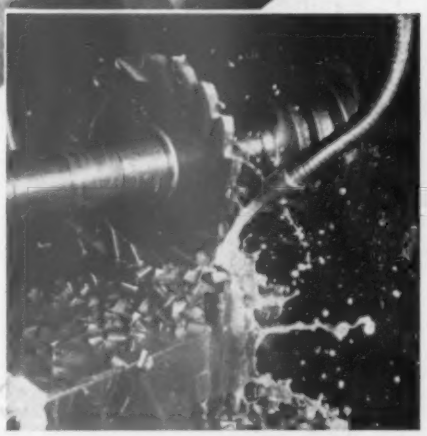

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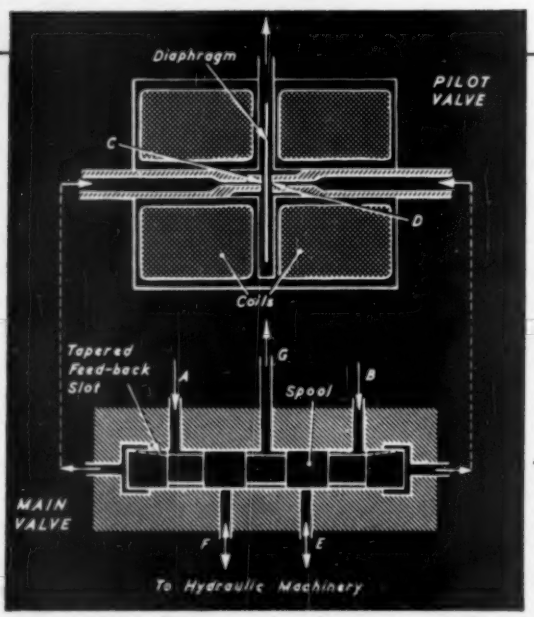

The valve — see diagram — consists of a main valve and a pilot valve. The main valve is supplied with pressure oil through ports A and B. When the spool is in the central position — as shown — the oil escapes through the tapered slots to the opposed jets C and D in the pilot valve and impinges on each side of the diaphragm. The two coils can be energised to attract the diaphragm towards one or other of the jets. If the signal to the right hand coil is the stronger, the diaphragm will flex to the right, restricting the flow from the right hand jet and thus increasing the pressure in that line. Similarly, the pressure in the left hand line is reduced. This pressure difference is transmitted to the main valve and causes the spool to move to the left until the resultant decrease in discharge area of the tapered slot at the right hand end of the spool and the increase in that at the left cause equilibrium to be restored. The displacement of the spool uncovers ports E and F, thus opening pressure and return lines to the hydraulic machinery.

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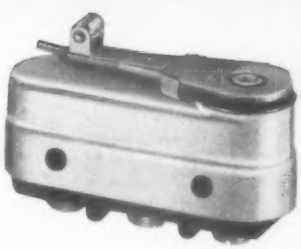

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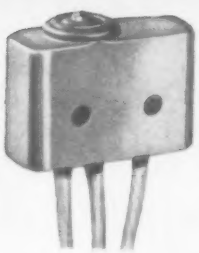

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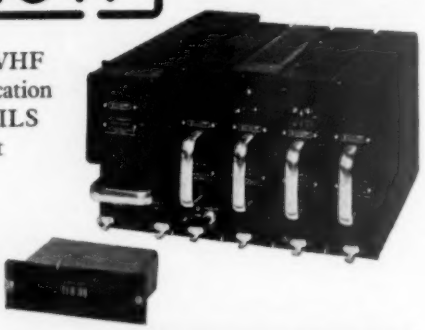

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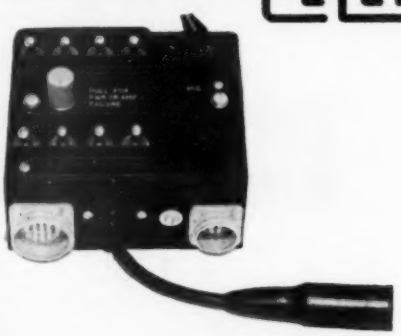
Interphone and Audio Control Systems



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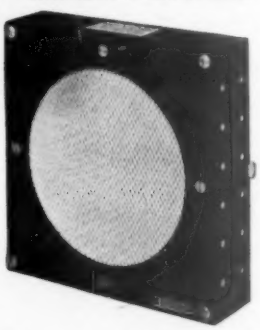

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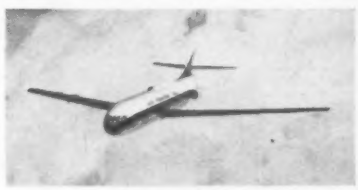

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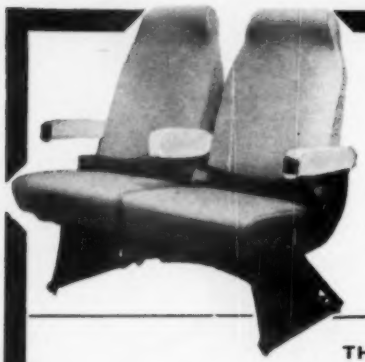

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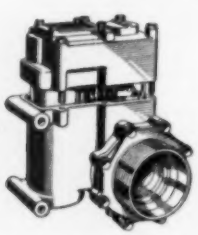

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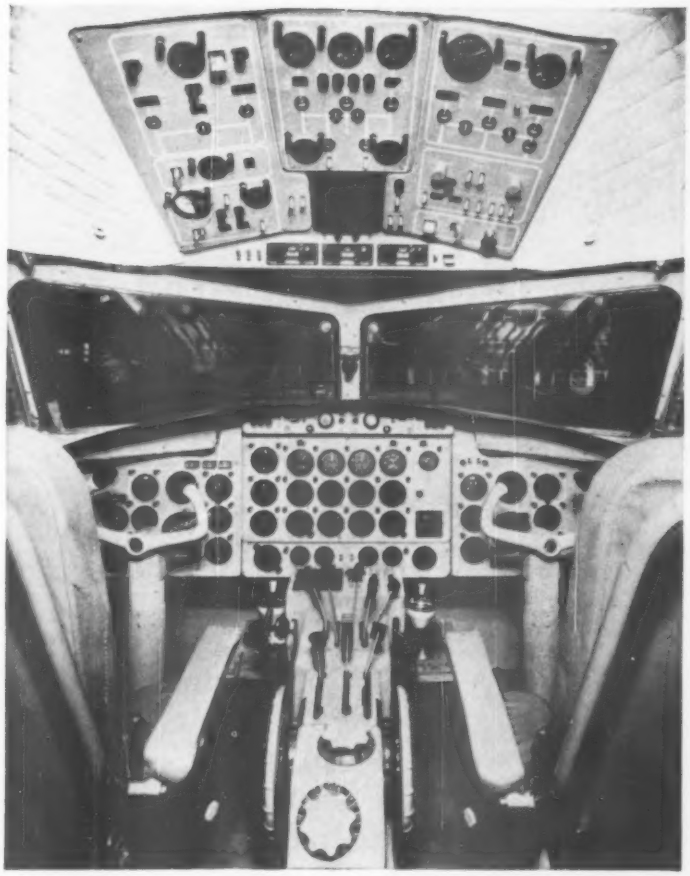
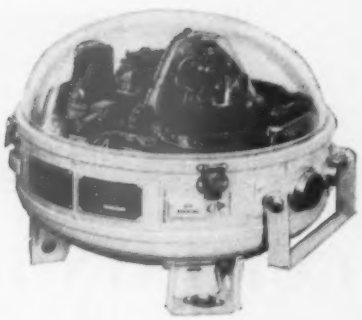


The Avro 748 relies on Smiths instrumentation. Altogether, 33 items of flight, engine and airframe equipment, from the SEP 2 Autopilot to the fuel gauging system, are used in this outstanding British aircraft.

In aviation, Smiths—a name with a world of meaning—means one organisation superbly equipped and backed by extensive design, research and engineering facilities. One contact to solve all your instrumentation problems whether they are engine, navigation, fuel measurement or flight control. If it's instrumentation, Smiths can put you in the picture.



The Gyro Unit forms the heart of the Smiths SEP 2 Autopilot used in the Avro 748. The rate/rate system of control employed has proved itself with more than a million and a half flying hours with 38 airlines and air forces throughout the world. Detachable assemblies simplify maintenance, and the unit is fully approved to operate for 3,000 hours between overhauls.

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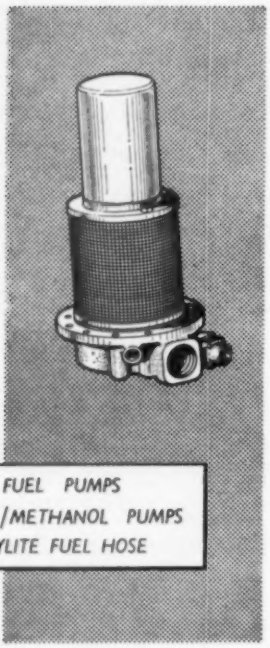

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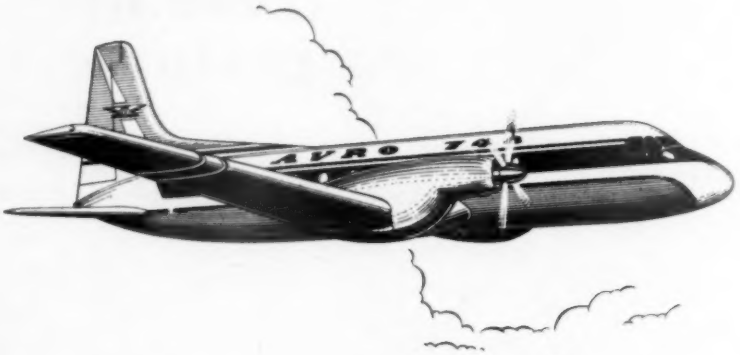

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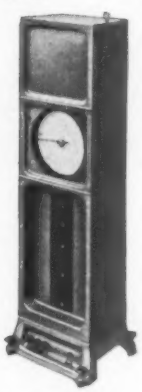

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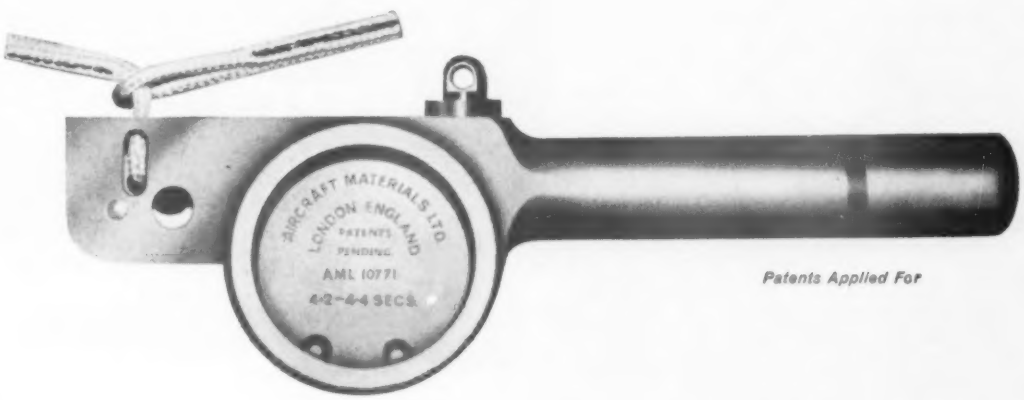

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Safeguarding the Future

One thousand million pounds sterling is a sum of money that represents extremely good business in anybody's language. As the total earnings of the British aircraft industry in the export markets of the World during the 15 years that have elapsed since the end of the War, it is an achievement to be proud of. So also is the export effort of our aero-engine manufacturers who have been responsible for earning about a third of this impressive total. And the rate of income still shows no sign of diminishing.

As an indicator of the industry's general health the export graph has long served as a useful "thermometer." But like all such instruments its readings must be interpreted with caution otherwise a misleading indication might easily be gained. In fact it cannot be too frequently stressed that, as Lord Kindersley, chairman of Rolls-Royce, said quite recently in his annual report to his company's shareholders, the record export figures for last year—which are apparently being maintained this year—are the result of decisions taken and development work done many years ago. The present period of transition from an era of almost unlimited development to one in which the overall number of military projects is drastically reduced will have its inevitable effect on the export graphs of the future. It may be the big new combines that now form our reconstituted industry will be in a better position to counteract any adverse tendencies in the export business than would the smaller individual components acting on their own. But although the factors on one side of the equation may vary, according to circumstances, on the other there will remain the steadily increasing effect of strenuous competition from abroad.

The only common factor that can be brought to bear to keep up the answering pressure is a complete continuity of technical superiority. This counts for a great deal in the export markets and without it there will inevitably come an irretrievably steep descent of the export income curve. And the only way to ensure constant technical superiority is to make certain that there is no loss of continuity in research and development.

Although, so far as exports are concerned, there are no immediate prospects for the new technology of astronautics, in no area at the present time is research likely to be so fruitful; and last week the Minister of Aviation had some interesting observations to make on this subject. It is virtually impossible, he said, to assess the benefits which may accrue from the exploration of this uncharted field; we can see clearly various practical applications of space research . . . but its potentialities are still largely unknown. He went on to make the nice point that, most likely, applications "which we have not yet thought of, will become indispensable for essential purposes, which we have also not yet thought of."

We have long argued that there are a good many complementary advantages to be gained from taking part in space research—even though by force of circumstances our particular contribution cannot be so large or so spectacular as that across the Atlantic. One of the best reasons why any form of exploration is worthwhile is that there are always such exciting possibilities. As Mr. Sandys said, the fact that we really have no idea where space research might ultimately lead, may perhaps be the best of all arguments for going ahead and finding out. The vital thing is to get started.

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Matters of Moment

Indian Interest in the VC10

AIR INDIA is one of the first airlines outside Britain to acknowledge its interest in the Vickers VC10 as possible future equipment. Speaking in London recently, Mr. A. C. Gazdar said his airline was "very interested" in the VC10, which seemed to suit Air India's route pattern. A team will probably be sent to the U.K. to evaluate the VC10 before the end of the year.

Replacement of the Super Constellation fleet is now being considered by Air India, and the VC10 is obviously of interest since it would be capable not only of operating economically on the medium stages at present flown by these aircraft, but could also be used on the Bombay-London-New York route most effectively. Another point in favour is the Rolls-Royce Conway engines, with which Air India has been most impressed in its Boeing 707s. "We should be very happy," said Mr. Gazdar, "to use the development of these engines in any future equipment we may obtain."

Mr. Gazdar also said he was particularly concerned with delivery dates, and that American and other British types are being studied, as well as the VC10.

U.S. Air Investment in Italy

FOLLOWING the trend already conspicuous in France for U.S. companies to invest in French aircraft concerns, the Raytheon Manufacturing Co. of Waltham, Mass., has acquired a 40% interest in a newly formed Italian company, Selenia S.p.A., for a reported investment of three million dollars. Selenia S.p.A. will be responsible for the major part of Italy's production of the Hawk missile for NATO and will also manufacture radars, microwave communications equipment, electronic test equipment and products in the new field of industrial controls.

The Italian companies concerned are the Societa Edison and Finmeccanica with, respectively, a 20% and a 40% holding in the new company.

The new company will be formed by combining the assets and plant of two subsidiaries of the Italian companies. Sindel, a subsidiary of Edison, will provide the headquarters and laboratories of the new company. Situated just outside Rome, Sindel's establishment is one of the most modern and best equipped in Italy and was brought into operation by Edison in 1959.

Finmeccanica, which is a State-financed holding company of 27 manufacturing concerns, will provide the main manufacturing plant for the new company near Naples, where its subsidiary Microlambda has an electronics plant which has been in operation since 1952. The combining of the resources of these two companies will eliminate any delay in starting operations.

This is Raytheon's second venture in Italy. The U.S. company already has a large holding in Elsi, an electronics company with a modern plant at Salerno.—T.D.C.

An M.o.A. Appointment

FROM the Ministry of Aviation came the news last week that Mr. Morien B. Morgan, C.B., M.A., F.R.Ae.S., had been appointed Deputy Controller of Aircraft (Research and Development). In this appointment—which takes effect in September—he will succeed Dr. W. Cawood, C.B., C.B.E., B.Sc., Ph.D., whose appointment as Chief Scientist to the War Office was recently announced.

Mr. Morgan, who has been Scientific Adviser to the Air Ministry since last year, was born in 1912 and was educated at Rutlish School and St. Catharine's College, Cambridge. At Cambridge he obtained a Bachelor of Arts degree with 1st Class Honours in the Mechanical Science Tripos and was a winner of the Seeley Prize in Aeronautics. After serving an apprenticeship with Mather and Platt, Ltd., he went to the Royal Aircraft Establishment in 1935, where, as a member of the Aero department, he was engaged on general flight research and development. In this field he subsequently specialized in stability and control problems, on which he became an authority.

He was appointed as head of the Aero Flight Section at R.A.E. in 1946 and remained in that post until 1948, when he became head of the Guided Weapons Department. In 1953 Mr. Morgan was appointed Deputy Director of the Establishment—a post he held for six years until he went to the Air Ministry in 1959. He was awarded the Royal Aeronautical Society's 1957 Silver Medal for his contributions in the execution and direction of aeronautical research and development.

Ten-Figure Exports

LAST week the Society of British Aircraft Constructors was able to announce that the export of British aeronautical equipment since the War had succeeded in topping the £1,000 million mark. The exact figure quoted is £1,007,075,403 and it is recorded, too, that to the aero-engine industry no less than £314,619,023 of this can be credited. The Society points out that the current annual rate of export earnings of more than £150 million "maintained since and including 1958" is equivalent to a sum of about £3 per year per head of the United Kingdom population. This is compared with a figure of £2 4s. for the United States; 12s. for France; £1 2s. for the Netherlands; and 1s. 8d. for Italy.

For the month of May, the total was £13,211,136, bringing the grand total for the first five months of 1960 to £65,028,220 and representing an annual earning of £156 million. The May total includes £3,612,694 for aircraft and £2,034,031 for aircraft parts; 91 new aero-engines valued at £3,282,293 and 94 others at £1,660,449; £2,094,390 worth of aero-engine parts; £248,821 for electrical apparatus; £103,275 for tyres; and £175,183 for instruments.

Some interesting figures are also quoted for the export efforts of certain S.B.A.C. member companies making such items as undercarriages, flight refuelling equipment, gun-sights, parachutes, ejector seats, fuel tanks, and other ancillaries for ground and airborne use, which do not find their way into the main tabulation. It is said for example, that the Dowty Group has sold more than £12 million worth of its undercarriages, pumps, accessory drives, propellers and hydraulic and electrical components to 41 countries. Flight Refuelling's contribution in this direction is given as £3 million; Martin-Baker's as £4.5 million; Ultra Electronics rescue and intercomm. equipment as £5 m. and Lucas fuel systems as £8 m. From the Sperry company comes news of £3 million worth of exports during the past five years. These useful contributions and many others—to say nothing of royalty and licence incomes—all help to make even the £1,000 million figure a conservative one.

More Soviet Records

DETAILS of several new record performances have recently been submitted by Russia to the F.A.I. for confirmation. Most significant is the speed of 2,091 km.p.h. (1,299.24 m.p.h.) over a 100-km. closed circuit in a single-jet T-405 by Boris Adrianov. This flight, made on May 28, exceeded by 83 m.p.h. the performance by Brig. Gen. Joseph H. Moore of the U.S.A.F. in a Republic F-105 last December. The latter record has not, to date, been confirmed by the F.A.I.—the 1,785 km.p.h. (1,109.12 m.p.h.) of G. Muselli in a Dassault Mirage III being the standing record in this class.

Once again, the aircraft used in this latest Russian record attempt is concealed behind a designation which is more probably an identity mark than a type number. It is likely that the record was in fact set up by a Sukhoi delta fighter, at least one type of which is believed to be in service with the Soviet Air Force. Russia still holds, incidentally, with the "E-66," the World speed record for aeroplanes at 1,493 m.p.h. The U.S.A.F.'s Convair F-106 record attempt of last December, averaging 1,520.9 m.p.h., has not yet been homologated.

Two parachute records are claimed for Lt.-Col. P. I. Dolgov, who has made more than 1,200 jumps in the past 20 years. On Jne. 3 he jumped from 12,974 m. (42,565.5 ft.) for a night record, and on Jne. 7, from 14,835 m. (48,671.5 ft.) for a day record.

Three World glider records are claimed by Russia, two for flights in the single-seat A-15 by Michel Veretennikov and one by Victor Iltchenko in the two-seat A-20. Veretennikov achieved a speed of 111.358 km.p.h. (77 m.p.h.) over a 100-km. circuit, and a goal flight of 700 km. (435 miles) from Kalouga to Stalingrad. Iltchenko made a goal flight of 600 km. (373 miles) in the multi-seat category.

In the F.A.I. Records Feminins category, Tatyana Russiayan has established speed and distance records for helicopters. Flying an Mi-1 she covered a 500-km. (310-mile) circuit in 3 hr. 31 min. 42 sec. at an average speed of 142,642 km.p.h. (88.6 m.p.h.).

V-bomber Ejection

A DEVELOPMENT of great importance to flight safety in Bomber Command was the live ejection on Jly. 1 by Mr. W. T. H. Hay, in a rearward-facing Martin-Baker ejection-seat, from a Vickers Valiant of the Ministry of Aviation. Ejection seats have long been required for the three rear crew members

in the Valiant, Vulcan and Victor, whose pilots have always had these escape aids, but their installation is complicated by the comparatively extensive airframe structural changes which would be necessary.

The latter problems remain to be solved, but last week's trial which took place at 1,000 ft. and 250 knots, completed the first stage of development in proving that ejection with rearward-facing seats presents no special difficulty. The Valiant was flown by Sqn. Ldr. Ware of the Bomber Command Development Unit, and the trial, at Chalgrove, was watched by senior officers of the Command H.Q., the M.o.A. and the R.A.F.

Vanguard Airborne Again

VICKERS resumed test-flying with the Vanguard on Jly. 4, using Tyne engines which have been specially cleared by Rolls-Royce for a short period. Priority is being given to a few small items which remain outstanding on the first Vanguard, G-AOYW, and to the T.C.A. Vanguard test programme. It is likely to be several weeks before production Tynes are cleared for use in the six B.E.A. Vanguards, which are meanwhile being modified to final delivery standard at Weybridge.

The key to the problem in the Tyne's compressor wheel, which led to the engine being withdrawn from flying on May 24, was found in the heat-treatment process. Rolls-Royce said on Monday: "The temperature at which the heat-treated forgings were tempered was found to relieve insufficiently the stresses produced by the quenching operation."

It is clear that new forgings will be needed for the Tynes already built, and their production will necessarily take some time. Vickers hope that deliveries of production engines will begin by mid-September, so that fully certificated Vanguards can be handed over to B.E.A. and T.C.A. before the end of the year.

Flying Crane or Helicopter?

LAST week's papers contained references to a "giant" new British helicopter variously reported as being capable of carrying 18 cars and 19 passengers or 250 passengers at cut rates; the ranges given were between 100 and 350 miles. One report suggested that if the design were modified to use six instead of 12 engines and the rotor diameter cut from 140 to 100 ft., the speed could be pushed up from 100 to 170 m.p.h. Credit was given to an advance project team at Blackburns for the design. Hawker Siddeley, of which vast group Blackburns is now part, confirm that such a project exists but it is, their spokesman was careful to point out, only one of the large number which are constantly being reviewed by the Hawker Siddeley board. This in itself is interesting in so far as it is generally expected that Government support for helicopters is expected to be limited to the Westland Group.

It is worth noting that the Hawker Siddeley interests have hitherto not covered helicopter construction.

Such a project is obviously of much interest to organizations concerned with transporting heavy loads of passengers and vehicles over short distances; operators of Channel ferries are an obvious example. To such operators the advantages of a detachable pod must appear very real. To them the great problem is how to reduce turn-round times; and pre-loaded pods, particularly if they could be designed to carry fuel as well as passengers, are an obvious answer.

Equally interested, in view of the military insistence on the need for modern armies to have flying cranes capable of transporting 50-ton tanks, will be those responsible for planning Army supplies. In this country, of course, the Army is limited to extremely small helicopters. Its needs in larger sizes are provided by R.A.F. Transport Command.

A provocative consideration is the question of whether a flying crane becomes a helicopter within the meaning of the limitations in Army equipment. In these days of very high thrust to weight ratio, design of a flying crane obtaining its lift from jet thrust is conceivable and it presumably would not rank as a helicopter. Is the Army unable to acquire for its own use flying cranes, which are unlikely to be of interest to an air force?

Finally, in assessing the merits of the project as so far disclosed, it is pertinent to recall that Mr. Leslie Frise has been working for Blackburns for a considerable time now, but that before he did so, he was directly concerned while at Hunting Percival Aircraft with the design and construction of a helicopter incorporating many novel features.

Flapping Wings Which Worked

A STIMULATING example of the benefits that the linking of the Man-powered Aircraft Committee (now the Man-powered Aircraft Group of the Society) with the R.Ae.S. is provided by an article in the July issue of the *R.Ae.S. Journal*. This takes the form of a valuable paper by Alexander Lippisch which, we have no doubt, would have been unlikely to find a publisher had not the Society's *Journal* been available to make public the observations and records of the distinguished German sailplane and tailless aircraft designer.

One of the most interesting achievements of MAPAG has been the bringing to light of facts about comparatively recent attempts to achieve man-powered flight. In Herr Lippisch's paper "Man-powered Flight in 1929" readers of the *Journal* will discover how nearly successful was a man-powered aircraft built in Germany in 1929. What is even more interesting is that it had flapping wings as did the Hartman glider of which we heard so much a few months ago (THE AEROPLANE AND ASTRONAUTICS, Oct. 30, 1959).

The Lippisch paper has diagrams which show how the flapping mechanism worked. It is to be noted that the author is still of the opinion that wing-flapping (for this purpose at least) gives a better efficiency than an airscrew. Even more provocative is his comment, bearing in mind the need to achieve the lowest possible weight, that the aeroplanes which flew with the lowest power per unit of weight were biplanes.

It is also to be noted and, we hope, to be acted upon that the Lippisch ornithopter had no ailerons and that this resulted in an early crash!

PRESIDENTIAL HERALD.—A Dart Herald was given the distinction of being chosen as the aircraft in which Dr. Arturo Frondizi, President of the Argentine Republic, travelled from Holland to Gatwick for his official visit to the U.K. Here the President disembarks from the Herald on Jly. 4 to inspect the R.A.F. Guard of Honour.

Matters of Moment . . . .

Changes at Duxford

WHEN CIBA (A.R.L.), Ltd., held its 25th birthday party at Duxford last year (THE AEROPLANE AND ASTRONAUTICS, May 29, 1959), many people learned with regret that Dr. N. A. de Bruyne, M.A., Ph.D., F.Inst.P., F.R.Ae.S., the company's managing director had decided not to offer himself for re-election to that post in 1961. He felt, he said, that the time had come for him to do some of the other things he wanted to do in the realm of science. Official confirmation of this decision has now come from the company and although there is no further news of Dr. de Bruyne's plans it is disclosed that he proposes to concern himself with research and the development of scientific instruments. His many friends in the aircraft industry will wish him well in these new ventures.

Born in 1904, Dr. de Bruyne was educated at Lancing College and Cambridge University. In 1928 he was elected a Prize Fellow of Trinity College for research work at the Cavendish Laboratory. The following year he learned to fly and became interested in aircraft structural problems. This led him in 1934 to set up, at Duxford, his own laboratory and airfield. He built the Snark monoplane to incorporate his ideas on stressed plywood construction and this he flew himself.

From this small beginning Aero Research, Ltd., as he called his company, grew into a thriving concern specializing in the problems of structural adhesives. Dr. de Bruyne, however, did not lose contact with the University and in 1937 he was appointed lecturer and university demonstrator in mechanical sciences.

In 1947, a controlling interest in Aero Research, Ltd., was acquired by CIBA, Ltd., of Basle, but Dr. de Bruyne remained as managing director. In 1958 the British company's name was changed to CIBA (A.R.L.), Ltd.

It is good to hear that Dr. de Bruyne's stimulating influence will still be available to the company in the future for he is to remain on the board. CIBA (A.R.L.) will now have joint managing directors—Mr. R. F. G. Lea, O.B.E., M.A. (who will also be deputy chairman), and Mr. D. A. Hubbard. All these changes will take effect from January 1, 1961.

Mr. Lea joined Aero Research in 1937 and has been a member of the board since 1946. Mr. Hubbard joined the company in 1939 as works manager and was elected to the board in 1958.

Aviation in Parliament

THE Rome conference; silencing of aircraft engines; high-density air traffic control; Customs facilities at Biggin Hill; a London heliport; and man-powered flight have all come before Parliament in the week under review.

Rome conference.—The purpose, Mr. Sandys told Mr. Hector Hughes (Lab., N. Aberdeen) was to discuss arrangements for setting up an international organization—Eurocontrol—for controlling aircraft flying at high altitudes over Western Europe. Subject to certain reservations by Italy, a draft agreement was approved in principle.

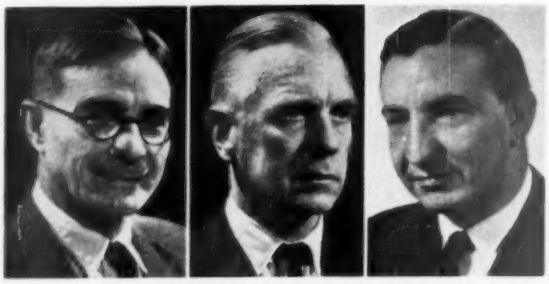
Silencing.—Suppressors that reduce the noise of jet engines in flight without excessive loss of power have been developed and are already fitted to many aircraft, including the Comet 4 series and to the Boeing 707s, Mr. Rippon, Parliamentary Secretary, told Mr. Gresham Cooke (Cons., Twickenham). He was reminded by Mr. Cooke that before the War the Puss Moth had a silencer box fitted.

Traffic control.—Mr. Rippon told Mr. Hall (Cons., Wycombe) that discussions have been started within the Eurocontrol organization on the need for a Decca-type system in Europe. Mr. Sandys was also arranging for similar talks to be held with other countries interested in high-density air traffic control problems.

Biggin Hill.—Mr. Sandys told Mr. Hector Hughes that he was not satisfied that there was sufficient international air traffic at Biggin Hill aerodrome to justify the provision for Customs facilities at present, but he would be prepared in consultation with the Chancellor of the Exchequer to review the position in the light of developments.

London heliport.—Mr. Sandys expects shortly to have the report of a technical committee set up in July, 1959, with the task of recommending possible locations for heliports in London.

Man-powered flight.—Mr. Rippon told Mr. Teeling (Cons., Pavilion) that in the absence of any foreseeable military use it was difficult for the Government to undertake to give any financial support. It was hard to see that this had any future other than as an interesting sport. It was possible that financial assistance could be obtained through the Royal Aeronautical Society. Asked if wind-tunnels could be made available for tests, he said that in appropriate cases he was sure the Government would provide that sort of facility. Mr. Teeling had said, raising an adjournment debate, that a 40-m.p.h. two-seater "flycycle" was being developed at Queen's University, Belfast, with an 8½-ft. propeller mounted in the tail. The designer believed that if mass-produced it could cost under £300 but the prototype might cost £8,000 to £10,000.



Left to right. Dr. N. A. de Bruyne, retiring managing director of CIBA (A.R.L.); Mr. R. F. G. Lea; and Mr. D. A. Hubbard.

Cables Cause Italian Helicopter Crashes

DURING manœuvres in the mountains of north-east Italy, the Italian Army lost two helicopters in crashes involving the death of four senior Army officers and two sergeant pilots. The two accidents, although entirely unconnected, took place within an hour of each other on Jne. 29. In each case the aircraft involved was an Agusta Bell 47 G.

In the first accident, a helicopter transporting General di Stefano of the 5th Army Corps hit an overhead mountain cableway, crashed and burnt out. The general and the other two occupants lost their lives. In the second accident, a helicopter which had just taken off after picking up two senior Army officers hit some high-tension cables. In this case, too, the aircraft burnt out before its three occupants could be rescued.—T.D.C.

MILITARY ANTONOV.—A revised rear fuselage, incorporating a loading ramp and a tail gunner's position, distinguish the military version of the turboprop An-10, now in service with the Soviet Air Force. This example, in temporary civil markings, carried Russian cars to Paris for the Summit meeting in May.

Aviation News in General

BRITANNIA STATISTICS.—By the end of May, Bristol Britannias had flown some 330,000 hr. (including 229,000 with B.O.A.C.) and are now averaging 14,500 revenue or mission flying hours a month. Delayed departures attributable to engineering snags have dropped from just over 10% in 1959 to 7% in April and May this year, averaged over all civil operators and the R.A.F. Britannia movements average 15 a day at Idlewild—the most ever achieved regularly at that airport by a non-American aircraft.

PIAGGIO P.166 ORDERS.—A second Piaggio P.166 (VH-PAU) has been delivered to Papuan Air Transport, Patair. The Italian oil company, AGIP Mineraria, has also ordered a second P.166.

HONG KONG OVERHAUL.—A Continental Air Transport DC-4 has been flown from the U.K. to Hong Kong for overhaul by the Hong Kong Aircraft Engineering Co. This is the first European-operated aircraft to be overhauled in the colony.

SOVIET VTOL—Studies are under way at the Aviation Institute in Moscow on a series of Flying Platforms based on ducted propellers and in the same VTOL category as the Piasecki VZ-8P and the Chrysler Aerial Jeep. The studies cover a range of vehicles up to 40 tonnes in weight and are supervised by Sergei Ordjouikidze under the Russian rotary-wing pioneer, I. P. Bratukhin.

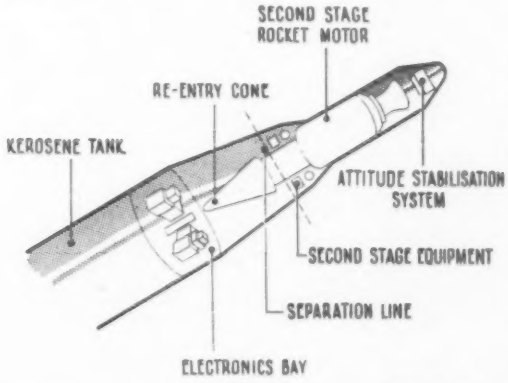
I.A.B.A. CONFERENCE.—The International Aircraft Brokers Association recently held its ninth annual conference in Helsinki. Dr. van Ginkel of Holland was elected president for the coming year.

SAFETY PROJECTS.—The 1960 supplement to the survey of research projects in aviation safety published by the Guggenheim Aviation Safety Center includes European projects for the first time. Tenth in the series, the 1960 survey lists 125 new projects, half of them of European origin.

SUMMIT LANDINGS.—Pilots from Sud-Aviation and C.E.V. have completed a series of successful take-offs and landings with a ski-equipped Alouette III on the slopes and top of Mont-Blanc (15,771 ft.). During these evaluation trials of its high-altitude characteristics, including engine relighting, the helicopter carried six people for the landing on the summit.

SEABORNE TEST.—First "live" firing of a Polaris ballistic missile from a submarine is expected within the next five weeks. Submarine concerned is the "George Washington."

PER ARDUA AD ASTRA.—A course on space for R.A.F. officers is being held at Bristol University, Jly. 11-21. Subjects range from rocket propulsion and scientific-satellites to aero-space problems and the military uses of space. Speakers are drawn from the Ministry of Aviation, R.P.E., Westcott, R.A.F. Institute of Aviation Medicine, Bristol Aeroplane Co., de Havilland Propellers, British Interplanetary Society, University of London and University of Bristol.



BACKWARD BOOST.—Upper section of two-stage Black Knight showing solid-propellent top stage mounted nozzle-forward for re-entry experiments. Ascending 300 miles under the thrust of Black Knight, top stage separates with the nose-cone already pointing Earthwards. Solid rocket falls some 230 miles before igniting to drive re-entry cone down into the atmosphere at 10,000 m.p.h.

DISCOVERER XII.—Yet another disappointment in the Discoverer programme occurred on Jly. 29 when a two-stage Thor-Agena rocket, launched from Vandenberg A.F.B., failed to place the satellite-stage in orbit. It carried an instrumented capsule intended to be ejected on the 17th orbit and recovered.

REJECTED?—Reports suggest that the Malkara anti-tank missile has been rejected by the Australian Army as "not meeting requirements." The Australian-built missile was adopted by the British Army last month.

POLARIS 1961.—According to the U.S. naval commander for Europe, Admiral H. O. Smith, the first Polaris missile-launching submarines will go into service with the Atlantic Fleet. One such vessel should be fully operational next year.

EURO-SPACE.—Sir Harrie Massey, chairman of the British National Committee on Space Research, has been appointed head of a five-man committee to prepare the ground-work for establishing the first European Space Research Centre. Appointment follows a two-day conference in Paris of scientists from 10 European countries.

Commercial Aviation Affairs

TALKS WITH PORTUGAL.—Negotiations to revise the civil aviation agreement between Britain and Portugal opened in London this week. The Portuguese delegation is headed by Mr. Victor Veres, Director-General of Civil Aviation, and the British delegation by Mr. M. V. Custance, deputy secretary, M.o.A.

CUBANA DIFFICULTIES.—Oil companies whose refineries in Cuba were seized last week by the Cuban Government are demanding cash payment for fuel uplifted by Cubana aircraft at all airports outside Cuba. Because of Cuba's dollar shortage, some flights are being operated with enough fuel for round trips from Havana and restricted payloads; other flights are being cancelled.

TROOPING TO GERMANY.—A trial air trooping movement for Service personnel from the U.K. to certain parts of Germany is to begin in October. British independent operators have been invited to tender for the job. The War Office says there is no question at the moment of replacing completely the troopships which carry Servicemen between Harwich and the Hook of Holland.

HIGH DENSITY.—The largest number of passengers—165—ever to arrive at London Airport in one aircraft was carried by a B.O.A.C. 707 on a flight from New York on July 3.

PRODUCTION JETSTAR.—This first production Jetstar was rolled out of Lockheed's Georgia Division plant last month. A total of 26 Jetstars have so far been ordered and the first deliveries are scheduled for January 1961.

AVIANCA BOEINGS.—Avianca, the Colombian national airline, has announced that it will purchase two Boeing 720Bs for use on the Bogota-Jamaica-New York route. Delivery will be in the autumn of 1961. The airline also proposes to lease jet aircraft for use on the routes from Colombia to Europe and to Ecuador and Peru later this year.

PAKISTAN NATIONAL.—All-Pakistani flight and cabin crews are now operating the chartered Pan American 707s on the London-Karachi route, some months earlier than at first planned.

ALITALIA MAKES A PROFIT.—Alitalia recorded a net profit of some £87,000 in 1959 after allocating £2,000,000 to cover amortization of aircraft and equipment. Alitalia has also announced that its capital is to be increased by £3,000,000 to a total of £14,000,000, presumably by means of a Government grant. A further £6,000,000 is to be raised by the issue of 10 million 1,000-lira bonds, bearing a 5½% interest.

B.E.A. HERON.—B.E.A. has now replaced the Heron ambulance which crashed at Islay three years ago. The new Heron, one of three used in Scotland, has been named "Sister Jane Kennedy" after the sister who was killed in the accident.

CYPRUS AIRWAYS.—For the second year running Cyprus Airways has paid a 25% dividend. At the A.G.M. on Jne. 28 the chairman, Sir Colin Raeburn, C.B.E., reported a 35% traffic gain during the year. On the Cyprus-London route operated in association with B.E.A., Comets replaced Viscounts on Apr. 1.

PRICE UP.—Following increases in the basic prices of the Boeing and Douglas jet transports, Convair have today increased by 4-4½% the prices of the Model 880 and 600. Basic prices before the increase were, respectively, $3.8 million and $4.36 million.

MISRAIR COMETS.—The second of three Comets ordered by Misrair was handed over on Jne. 28, three weeks after the first had been delivered. The third will be completed early next year. Misrair plans to open its Comet service to London on Jly. 16 at a frequency of five times a week, stopping at Rome and alternatively at Frankfurt, Geneva and Zürich.

RANSA STOPPED.—The operating permit of Rutas Aereas Nacionale S.A. (RANSA) has been withdrawn by the Venezuelan Government following allegations that it was involved in the attempted assassination of the Venezuelan president last month. RANSA is accused of flying people and equipment involved between the Dominican Republic and Venezuela.

T.W.A. FREIGHTERS.—Six L.1649 Starliners are to be converted for all-freight operations on the T.W.A. routes to Europe.

MELBOURNE HELIPORT.—Plans to build a heliport on the River Yarra in Melbourne have been officially approved and construction will begin at once. To be built on a pontoon, the heliport will be operated jointly by Ansett-A.N.A. and T.A.A. and will be used for a helicopter service to Melbourne Airport, eight miles distant.

ICAO MEMBER.—Kuwait has become the 78th member state of the International Civil Aviation Organization.

News About People

AVIONS FAIREY NEWS.—Following the retirement of Mr. Richard Fairey, chairman, and Mr. E. O. Tips, managing director of Avions Fairey, Mr. G. W. Hall, F.R.Ae.S., chairman of The Fairey Co., Ltd., is now also chairman of the Belgian company. Mr. Arthur Talbott is appointed managing director and three directors from the parent company—Mr. J. C. Macpherson, F.C.A., Mr. A. Vines, A.F.R.Ae.S., A.M.I.Prod.E., and Mr. C. C. Vinson, F.C.A.—complete the new Avions Fairey board.

WASHINGTON POST.—A. V. Roe Canada has appointed Mr. John R. Douglas as its representative in Washington. A new appointment, it completes the company's current programme of establishing representatives in various European and American cities.

B.O.A.C. APPOINTMENT.—Mr. Alan Ponsford, who has been deputy chief press and information officer of B.O.A.C. since Dec., 1958, has been appointed assistant on the staff of the managing director. For the duration of this appointment, Mr. T. I. Pyle, senior press officer will act as deputy to Mr. F. C. Gillman.

MOND AND WIGGIN.—Changes in the senior management of The Mond Nickel Co. Ltd., and its subsidiary Henry Wiggin and Co., Ltd., became effective on Jly. 1. Mr. G. Archer is now president of both companies, and is succeeded as chairman and chief officer by Mr. Ivon A. Bailey. Dr. L. B. Pfeil is appointed vice-chairman of Mond and Mr. J. O. Hitchcock becomes managing director of Mond and deputy chairman of Wiggin. Mr. H. W. G. Hignett is the new managing director of Wiggin.

REPORTING AWARDS.—Mr. B. C. V. Oddie, Deputy Director of Outstations Services (left) presenting one of the two annual Meterological Office awards to civil aircraft commanders to Capt. D. F. Redrup, B.O.A.C. The other award, also presented in the presence of Dr. K. G. Bergin, Master of GAPAN (centre) went to Capt. G. P. Lace of B.O.A.C.

Photograph copyright "The Aeroplane and Astronautics"

ALAN MARSH AWARD.—Mr. A. C. Jolly, who is studying at the College of Aeronautics, Cranwell, has won this year's Alan Marsh Award presented by the R.Ae.S. Rotorcraft Section to the student who has shown exceptional ability in technical study in the rotary-wing field.

The Alan Marsh Medal has been awarded to Flt. Sgt. Breach of the R.A.F.

CAPT. R. F. ADAIR.—We regret to record the recent death of Capt. R. F. Adair, O.B.E., in Brisbane. He was founder and managing director of Queensland Airlines, now a subsidiary of Ansett-A.N.A.

NORMAN RYDER.—We regret to record the death on Jne. 29 of Mr. Norman G. Ryder following a heart attack. After obtaining newspaper experience on the *Wolverhampton Express and Star*, Mr. Ryder was on the editorial staff of *Flight* before joining B.E.A. At the time of his death he was deputy public relations officer of that airline.

Air Transport

Lord Terrington and the A.T.L.B.

EVER since the creation of the Air Transport Licensing Board was first mooted, a year or so ago, its possible composition has been a popular topic for discussion in airline circles, and many names have been suggested as candidates. In fact, it has always been apparent that continuity would have to be maintained between the work of the A.T.A.C. and the A.T.L.B. which was to succeed it, and that the most satisfactory way of achieving this would be to retain, at least temporarily, some or all of the members of the former body.

This, Mr. Duncan Sandys has now confirmed, is to be the case, at least so far as the chairman, Lord Terrington, is concerned. During the necessary transition period, from A.T.A.C. to A.T.L.B., both bodies will function in parallel, and Lord Terrington will take the chair of both. The names of other members of the Board will be announced later. The A.T.L.B. was brought into being by the Civil Aviation (Licensing) Act which became law on Jne. 2 when the Royal Assent was given.

As a result of the new regulations (our issue for May 20) which require "Y" transitional licences to be obtained for separate-fare holiday services in 1961, the A.T.A.C. is likely to be unprecedentedly busy in the last few months of its existence. By Jne. 23, the last date for bids to be made for 1961 inclusive tours, about 800 applications had been put in, compared with 580 last year. The applications include the names of several operators for the first time, and also indicate some possible re-equipment plans of other airlines.

Among the new names are those of Air Condor, an associate of Shortcut Aviation, planning to use Viscounts or DC-4s; Eros Airlines of Hampstead, applying for Viscount and DC-6 services; Maitland Drewery, which has a Viking and three Viscounts; and World Wide Aviation of Ascot, listing Viking and DC-6. Equipment trends are shown by the inclusion of Viscounts in the applications by Falcon, Orion and Silver City, and Constellations by Continental and Falcon.

No More Tourist Travel

TOURIST-CLASS air travel over the North Atlantic came to an end at midnight on Jne. 30, after an 8½-year life. From Jly. 1, in accordance with the IATA Traffic Conferences Paris Agreement of February, 1960, only two classes of service will be offered on the trunk routes between the Old World and the New. For the time being, at any rate, the cheaper class will be known as Economy on these routes, although in some other areas where the two-tier structure is being standardized the "tourist" title will be retained. De luxe services have already been abandoned, although the standard of comfort offered in propeller-driven aeroplanes is higher than that in the jets, at equal first-class fares which, since May 1, have been increased to the former de luxe level.

Tourist fares were introduced on the North Atlantic on May 1, 1952, and were set at 31.5% below the standard single and return fares and 20% below the "off-season" return fare then operating. On the London-New York route, the basic single fare was £96 9s. compared with the £141 2s. of what then became first-class service. Eleven airlines introduced tourist service on the opening date, offering initially some 2,400 seats a week in each direction over the Atlantic.

In their first full year, tourist fares led to a 31% increase in the total traffic over the North Atlantic and, by 1953, these services were carrying over half—63.3% in fact—of the scheduled transatlantic air passenger traffic. In 1957 tourist traffic had risen to 76.4% of the total.

With the introduction of economy class on Apr. 1, 1958, at fares 20% lower than tourist, the latter class inevitably dwindled in popularity. While first-class services continued to be supported at about the same level as before (largely, one may suppose, by "expense account" travellers) the great majority of those paying for themselves naturally chose the cheapest service. A chart published in our issue for Jne. 24 showed how tourist traffic had dwindled from 70.6% of the total in the last quarter before the introduction of economy class, to 2.6% of the total in the first quarter of this year.

Nevertheless, it has not easily been abandoned and B.O.A.C. in particular is known to have argued in favour of the retention of a three-tier fare structure over the North Atlantic in the IATA Traffic Conferences' abortive meeting in Honolulu last year. Faithful to its tourists to the end, B.O.A.C. was the only airline offering this class of service during June, all other airlines having dropped it by the end of May.

IATA estimated that 3,017,000 passengers would have crossed the Atlantic tourist-class by Jne. 30, representing 43% of the total traffic in the 98-month period of its existence. Since May 1, the basic one-way economy jet fare on the London-New York route has been £96 9s.—which is exactly the same as the original tourist fare eight years ago, the latter rate having, in the intervening period, crept up to £114 6s. On propeller aircraft the economy fare is £89 6s., and reductions of £11 are available on these fares between Oct. 1 and Mar. 31 each year. Also during this latter period—starting next October—the special 17-day excursions, at £125 (jet) and £114 (propeller) return, will be the lowest air fares ever offered over the Atlantic.

LONDON TERMINAL.—Work on the permanent B.E.A. Air Terminal at West Kensington—considered by many travellers to be the most inconveniently sited of any European city terminal—has now begun. To be completed in 1963, the £3½ million, 10-storey building, alongside the present temporary structure, will be able to handle seven million passengers a year.

Riddle Argosies Again

A FURTHER stage in Riddle Airlines struggle to re-establish itself on a firm financial basis was reached on Jly. 1, with the resumption of Logair flights for the U.S.A.F. When Riddle lost its Logair contract a year ago, the possibility that the company's provisional order for Armstrong Whitworth Argosies would be taken up seemed doubtful; but Riddle has now said it expects to take delivery of the first of five Argosies before the end of this year.

The Logair contract, which runs for three years, calls for scheduled operations to supply parts and materials to U.S.A.F. bases within the American continent. Each of three daily schedules will originate and terminate at Tinker A.F.B., Oklahoma. The annual mileage involved will be more than 4,500,000, and over the three years this contract should produce $20-25 million in revenue.

At present, 10 C-46s are committed to the Logair flights. These will be progressively replaced by the five Argosies, which will be the first turboprop freighters used by a U.S. airline. They will be particularly suited to carrying the "outsize cargo," such as high-priority jet engines and missile components, which are part of the Logair commitment.

The U.S. Fares Increase

THE C.A.B.-authorized increase in U.S. domestic air fares, reported in our issue for Jne. 24, is expected to increase the income of the domestic trunk lines by about $84 million a year. Averaging about 5% for the 12 airlines concerned, the increase is made up of a 2½% addition to all fares plus $1 per one-way ticket. The $1 increase—and the present jet surcharges—are intended to expire on Jne. 30, 1961, but the 2½% will be permanent.

These decisions are not, apparently, the C.A.B.'s last word in the General Passenger Fare Investigation. As already announced, it is intended that the average return on investment for the trunk lines over a reasonably extended period in the future should be at least 10.5%, and it remains to be seen whether the increases now sanctioned are adequate for this.

Rate of return for the local service airlines has now been set at 12.75% by the C.A.B., compared with 9.5% in the past. Local carriers will be allowed the same fare increases as the trunk airlines, but the rate of return decision is expected to increase the amount of subsidy paid to them by as much as $4.5 million a year.

B MODEL BOEING.—In this picture of the first turbofan-powered Boeing 707-120B concluding its first flight on Jne. 22, the increased size of the engine intakes is apparent. This particular aircraft will join the American Airlines' fleet after certification, and all that airline's 707s and 720s will eventually be turbofan-powered.

Air Transport . . . .

The Electra Fix

MODIFICATIONS to the Electra to increase the stiffness of the engine mounting and engine nacelles and to strengthen the wing are expected to take about four weeks per aircraft and to cost in the region of £55,000. Details of the modifications are still being worked on by Lockheed, and the necessary kits of parts and instructions will then be supplied to airlines using Electras, together with personnel to assist in the conversion programme.

Meanwhile, the speed restriction on the Electra remains in force, but the limitation on the use of the auto-pilot has been lifted. Further details of the investigation conducted by Lockheed into the reasons for the two accidents following structural failure, show that the critical speed range for undamped vibration being transmitted from an outer engine to the wing structure was 310-323 m.p.h. I.A.S. The normal Electra cruising speed of 317 m.p.h. I.A.S. was right in the middle of this range.

As already recorded (THE AEROPLANE AND ASTRONAUTICS, May 20) the oscillatory movement of the propeller/propeller shaft combination only became dangerous in an aircraft in which some damage had previously occurred to reduce the stiffness of the nacelle. The oscillations in the long-shafted Allison engine in such a case were not damped out, and in the critical speed range excited uncontrolled vibration in the outer wing panels. The theoretical calculations involved in explaining this phenomenon involved the solution of 59 equations each with thousands of possible combinations. This was done by electronic computer.

The Air-Freight Business

ONE of the sometimes unappreciated problems facing the designer of all-cargo aircraft concerns the compromise which has to be reached in agreed fuselage dimensions. A recent paper given by Mr. E. H. Higgins (chief engineer, aircraft, Canadair, Ltd.) shows that this problem is far from being a relatively simple one even when you have gone to the trouble to find out, by large-scale sampling methods, the average density of present air-cargo loads.

In fact, as such samplings have shown, the average varies quite considerably from airline to airline. Three recent researches produced figures which varied by 40%—10.2, 11.2 and 13.9 lb./cu. ft. But, even if an average of, say, 13 lb./cu. ft. is correct, you cannot just design an aeroplane which will carry its full payload when loaded to capacity with cargo of this density.

In practice, the average density of cargo required to achieve a 100% load factor will be at least 40% higher than that assumed in such a basic sum. The CL-44, for instance, has a maximum net payload of 63,000 lb. and a hold volume of 7,250 cu. ft.; the average cargo density is 8.69 lb./cu. ft. When allowances have been made for pallets, containers, mechanized loading and average stacking efficiency, the load-density for a maximum payload is 12.5 lb./cu. ft.

To determine the average payload which can be accommodated in a particular aircraft you have then to work out the effect of variations in actual cargo density on the probable load factor which will be achieved. As Mr. Higgins pointed out in his paper, it is obvious that, if an aircraft will accommodate an average cargo-density which is the same as the average density of the loads being offered, then this aircraft will be volume-limited some, and perhaps most, of the time.

Assuming an average cargo density of 13.1 lb./cu. ft., then the CL-44 cannot be expected to enjoy an average load factor of more than 94% even if full loads are always available. In an aircraft with a higher design load-density of, say, 16 lb./cu. ft., the probable average achievable load factor would be little more than 80%. But the operator cannot face the weight and drag penalties involved in very low design load-densities—so that 100% load factors will rarely be available in practice. Canadair's further analyses suggest that the most efficient aircraft is one which will have a "design density capability" which is slightly lower than the average density of the cargo which is offered.

Sharing the Load

OUR comments in last week's issue (pp. 8-9) about the passenger facilities at London Airport North were anticipated by a statement from the Minister of Aviation who explained one step which was to be taken to improve the situation. Mr. Sandys said, in the House on Jne. 27, that instructions had been given for the use of the Central Area's short-haul facilities "when the arrival of delayed or non-scheduled flights appears likely to cause congestion at the North Station."

He explained that the situation on Jne. 20 was caused partly by unavoidable delays in departures from New York and was further aggravated by the arrival of non-scheduled flights. Mr. Sandys added that "fortunately the peak period for the arrival of long-distance passengers at the North Station coincides with a comparatively slack period for the arrival of Continental passengers at the Central Station."

But what happens when the long-haul turbojets arrive in a bunch at a time when the short-haul terminal is working to capacity? Temporary extensions for the "North Station" might still be worth while; it will be more than a year before the new Central Area long-haul building will be available even for partial use.

Emergency Oxygen Requirements

THE complex and unpredictable problems involved in proposals for the mandatory supply of emergency oxygen for passengers in British transport aircraft are being met by revised rules which will come into force on Jan. 1, 1961. The form of the requirements follows closely that favoured by the majority of States present at the last meeting of the ICAO Airworthiness Committee.

As might be expected, the principal changes concern protection for passengers in cases of serious pressurization failure. Whilst an immediate emergency descent is still considered to be the primary safety procedure, the provision of passenger oxygen supplies will become mandatory. According to the

(*Continued on page 35*)

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Similar to the T.Mk.3. but fitted with armament in addition, the Jet Provost T.Mk.51. is in service with the Royal Ceylon Air Force.

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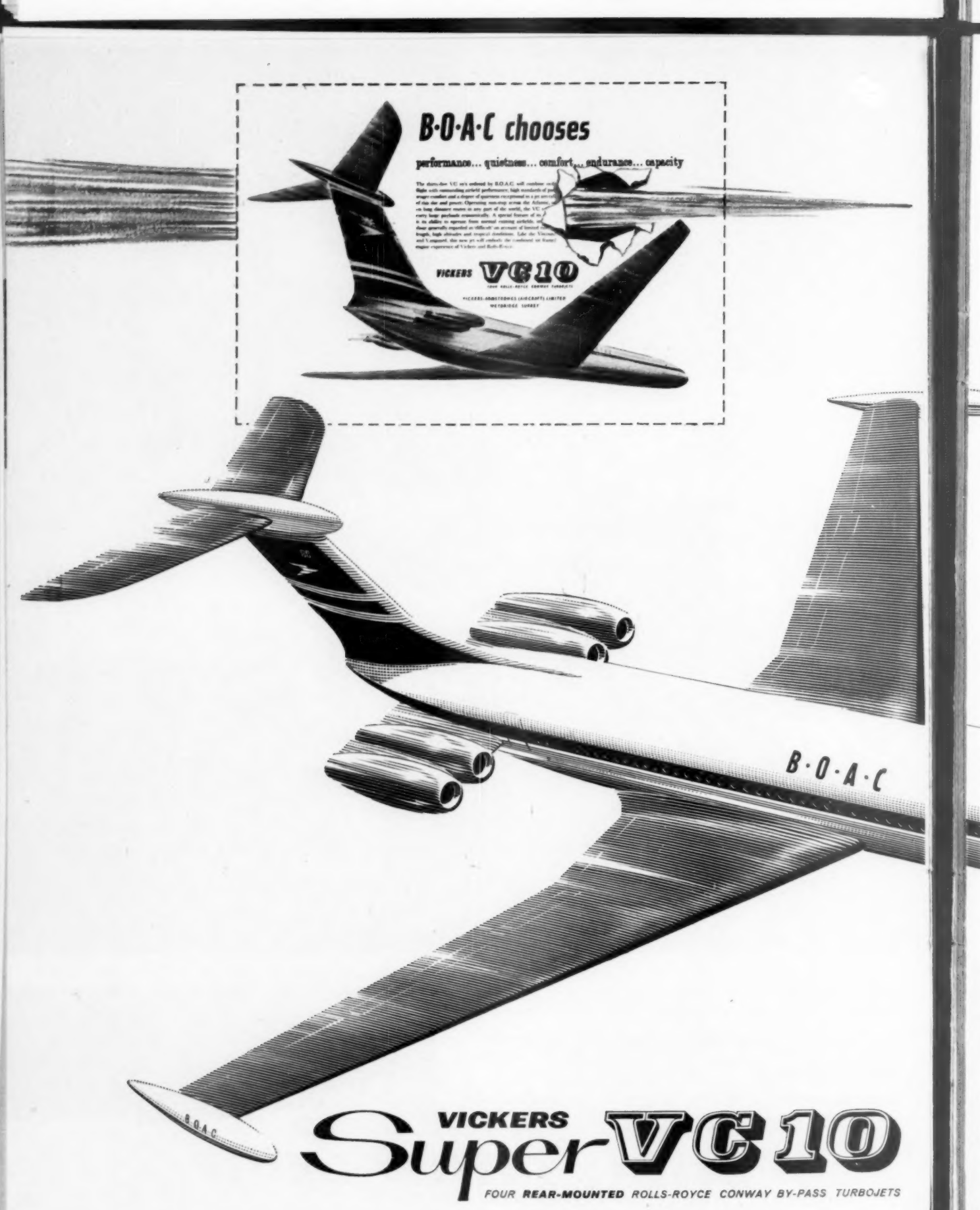
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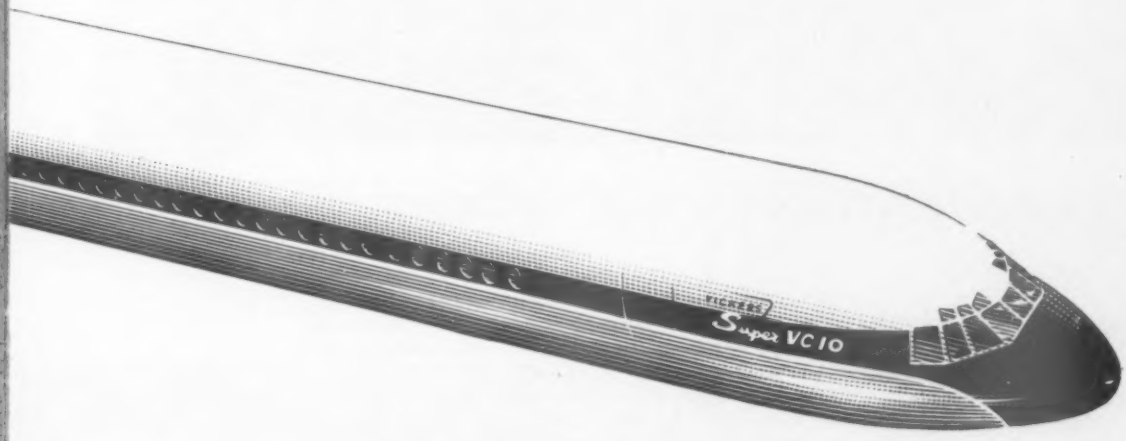

BOAC has followed its contract for 35 Vickers VC10 jetliners by ordering, from British Aircraft Corporation, ten Super VC10s—aircraft which are tailor-made for high-density routes such as the North Atlantic.

In an economy class layout the Super VC10 can carry up to 212 passengers plus 4 tons of freight non-stop from London to New York even against strong headwinds.

Both the Vickers VC10 and the Super VC10 with their new-look clean wings and rear-mounted engines will offer an airfield performance and a cabin comfort which will make them the most passenger preferred long-haul jets in operation.

BRITISH AIRCRAFT CORPORATION

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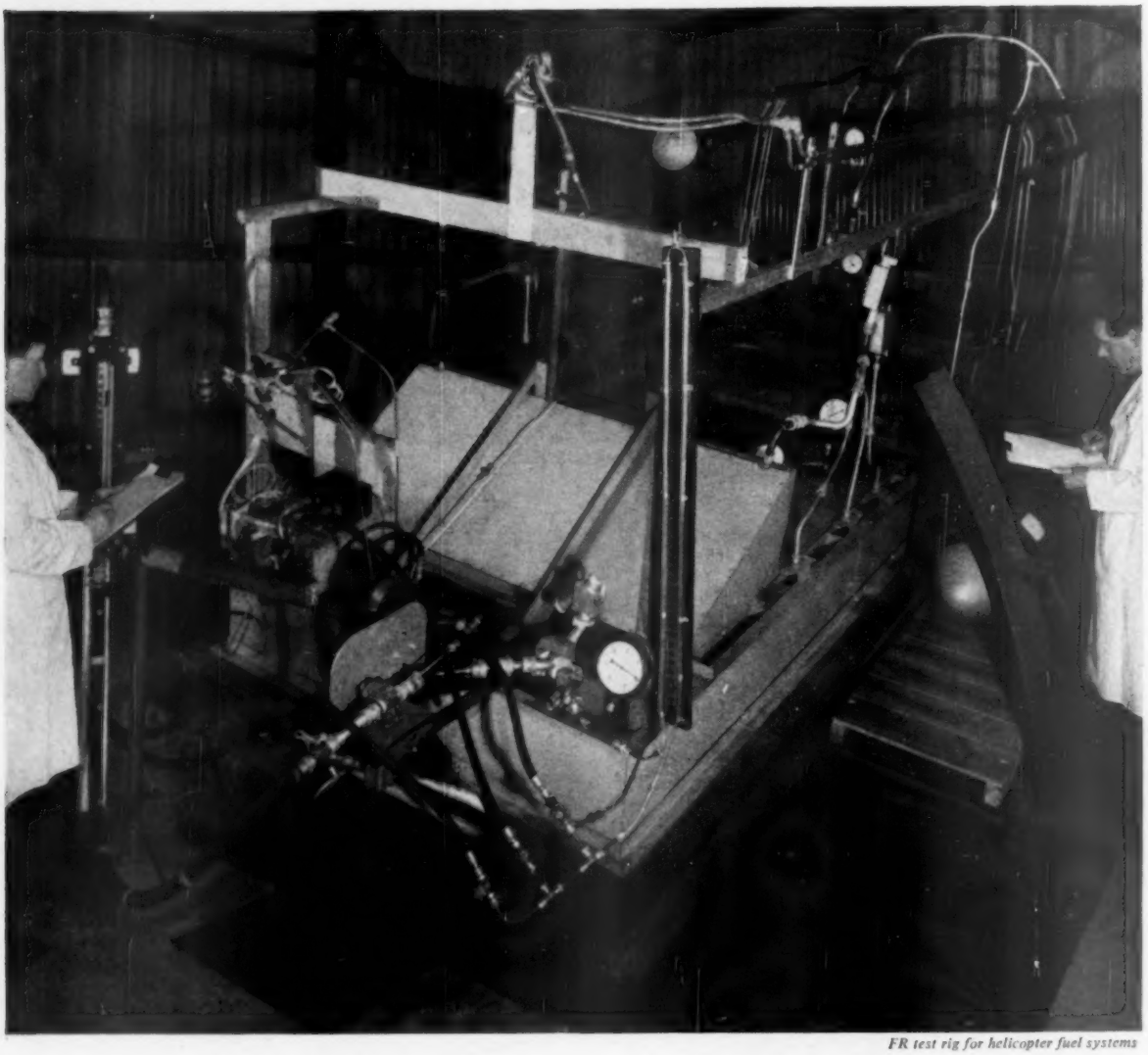

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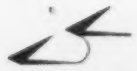


Flight Refuelling Ltd

Tarrant Rushton Airfield, Blandford, Dorset. Telephone: Blandford 501. Telegrams: Refuelling, Blandford

Air Transport . . . .

(*Continued from page 34*)

cruising altitude, up to 35,000 ft., and depending on an aircraft's ability to descend rapidly to 15,000 ft., such supplies will be required for specified percentages of passengers. Aircraft cruising above 35,000 ft., or those unable to meet stipulated minimum rates of descent, must have oxygen and equipment for all passengers, and the equipment must be such as to permit "self-help" at every seat position. There are other supplementary rules, but these are to be the broad requirements.

Up to 35,000 ft. the pilots are considered to be adequately protected if a rapid-donning mask, with automatic flow control, is worn "at the ready." Above 35,000 ft. the mask will be worn on the face.

The minimum percentages of passengers for whom emergency oxygen must be available in operations below 35,000 ft. represent the possible casualty rates which, according to medical statistics, may be expected in a representative passenger list. For instance, supplies for only 10% of the passengers will be required in aircraft operating at 30,000 ft. or below and during flights on which they are capable of descending to 15,000 ft. or less within six minutes, and of remaining at this altitude thereafter. Oxygen and equipment for flight-deck and cabin crew must be available on all flights above 10,000 ft. A normal cabin pressure of 700 mbs. or more (10,000 ft.) is assumed.

British Oxygen Aviation Services developments to meet these new requirements are recorded on page 57.

New ILS at L.A.P.

ACCEPTANCE test flying is now under way on the first of four new-type Instrument Landing Systems to be installed at London Airport. Manufactured by Standard Telephones and Cables and evaluated by the Ministry on the prototype installation at Hurn, the equipment is also to be used at Gatwick, Prestwick, Renfrew and Ringway (Manchester) where two systems will be provided at each airport.

At L.A.P. the first system, a temporary installation, is on runway 10 left and the second is nearing completion on runway 28 right. This latter system, housed in a semi-sunken building, is permanent with the exception of the glide-path equipment, which is mounted in a vehicle to allow for its movement when the runway extensions are completed. The two other systems will be for operation on runways 28 left and 10 right.

Known as the STAN 7-8-9, this ILS has a number of differences when compared with other equipment in this country. It has a "no reference" type glide-path, a dual-beam localizer radiation pattern and no back beam. The STAN 7-8-9 also includes fully automatic change-over for the dual localizer, glide-path and marker-beacon elements and a comprehensive monitoring and control system.

The localizer course pattern is generated by the simultaneous radiation from two independent course and clearance antenna arrays. The on-course path is provided by a broadside array of 12 horizontal dipoles which radiate an 18° beam centred in the direction of the approach and bisected by the runway centre-line. Located some 1,600 ft. from the upwind end of the runway, the array is 85 ft. wide and 7 ft. high. The clearance antenna comprises three horizontal wideband dipoles mounted on a 9-ft.-wide platform positioned centrally 50 ft. behind, and parallel to, the directional array. It provides navigational information outside the 18° sector covered by the course array.

Positioned some 800-1,600 ft. upwind from the runway threshold and offset to one side of the centre-line approximately 400-550 ft., the glide-path antenna consists of two horizontal dipoles mounted one above the other on a common mast. The intersection of the radiations produced by these two antennæ provide the descent path.

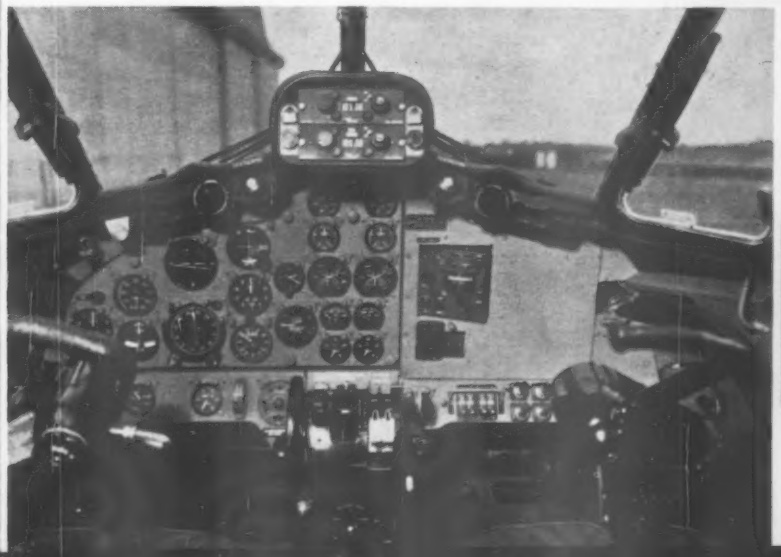
A typical range for the localizer course transmission is stated to be 25 n. miles at an altitude of 2,000 ft. and 75 n. miles at 10,000 ft. Omnidirectional and back course indication is provided by the clearance antenna and the glide-path range is greater than 10 n. miles.

The designation numbers "7-8-9" refer respectively to the localizer, glide-path and marker-beacon equipment. In fact, the marker beacons (9) will not be employed at L.A.P. as the existing Pye beacons can be modified.

New Executive Dove

THESE photographs of the Mk. 8 D.H. Dove illustrate the principal changes and improvements in this executive transport. The new Mk. 3 version of the Gipsy Queen 70, rated at 400 b.h.p. for sea-level take-off, has an ejector-type exhaust system which improves cooling, reduces drag and produces some useful thrust.

An obvious change in the external lines of the aircraft is that made by the Heron-type cockpit canopy to provide more headroom and space for equipment in the roof. An entirely new instrument panel and lighting system has been devised and advantage has been taken of the latest developments in compact, lightweight communication and navigation-aid equipment. Accommodation can be provided for up to six passengers. In the U.S.A. this variant will be known as the Dove "Custom 800."



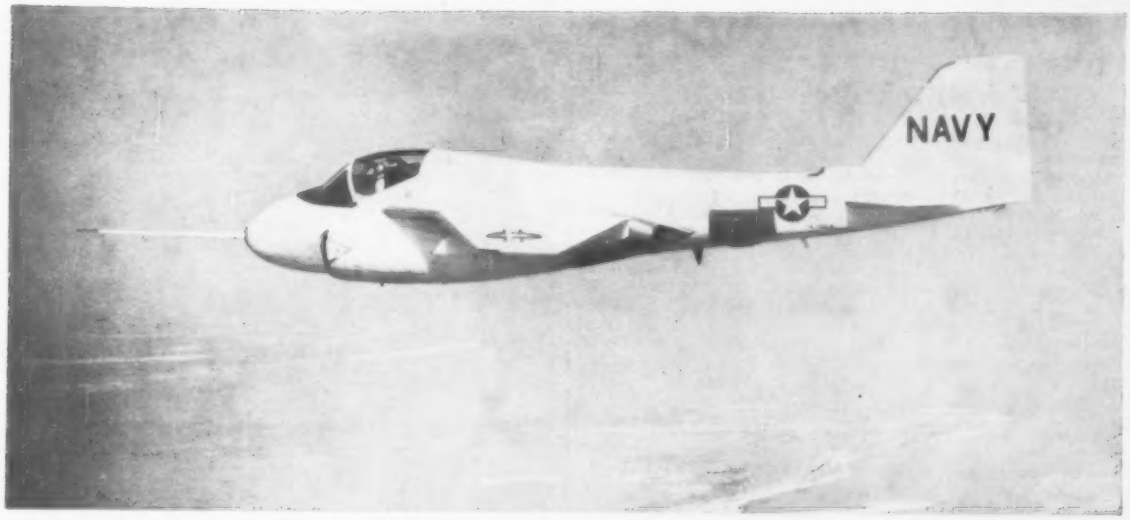
The U.S. Navy's Intruder

GRUMMAN'S latest aeroplane, the A2F-1 Intruder, continues the company's long association with the U.S. Navy, but at the same time breaks much new ground. Comparable in many ways to the Royal Navy's Blackburn NA.39, the Intruder is a high-subsonic-speed (Mach=0.9) low-level attack bomber equipped to select small targets for close support in all weathers, or to travel long distances to deliver, in the words of its makers, "a nuclear haymaker." Among the Intruder's more interesting features are the tilting jet tailpipes and DIANE, a Digital Integrated Attack Navigation system which enables the pilot to pre-select an attack programme and allow the aircraft to approach the target, discharge its weapon and leave the target area without further action unless he wishes to change the plan.

General characteristics of the Intruder are shown in the accompanying photographs and three-view general arrangement drawing. The moderately swept-back wing folds upwards—in typical Grumman fashion—to reduce the span from 53 ft. to 25 ft. 2 in. Engines are carried side by side in the lower front fuselage, this arrangement going well with the "staggered tandem" seating for the pilot and radar operator. Both crew members have Martin-Baker GRU5 ejection seats, variants of the Mk. 5 series of seat which can be reclined to reduce crew fatigue during low-level missions. The radar operator is slightly behind and below the pilot, to starboard.

Engines are Pratt & Whitney J52-P-6, each giving 8,500 lb.s.t. (compared with the 7,000 lb.s.t. de Havilland Gyron Juniors in the NA.39, which is a slightly smaller aeroplane). This twin spool powerplant, with the company designation JT-8, has been under development for several years with U.S. Navy backing and the Intruder is its first application to a piloted aircraft. It was originally designed for the Douglas A4D-3, which was cancelled, and also powers the North American GAM-77 Hound Dog air-to-surface missile.

This series of pictures of the Intruder on the ground (right and above) reveals a number of interesting features. The underside of the cockpit is recessed between the engines to carry a weapon or fuel tank, and the four wing pylons are clearly



The Intruder's control system is interesting, and appears from the illustrations to comprise full-span leading- and trailing-edge flaps, with inset ailerons or spoilers for lateral control ahead of the trailing-edge flaps. Air brakes are carried low down on the fuselage sides and operate partially in the jet exhaust. The tailplane has a variable incidence and may be of the all-flying type actuated in conjunction with the elevators.

To shorten the take-off run from carrier decks and improve the initial climb, the Intruder has unique tilting tailpipes, a short rear section of which can be hinged down about 30° by hydraulic actuators. This particular application of jet lift has not previously been used in an operational aircraft, but is similar in principle to that tested on a Nene-Meteor test bed in an N.G.T.E. programme some six years ago.

In the Meteor, the jet exhaust was deflected downward through a separate exit from the tailpipe, in contrast to the Grumman system. The conversion was designed and engineered by Westland Aircraft and the aircraft was handed over to the R.A.E. in August 1954. Test flying by the R.A.E. showed that stability and control were satisfactory down to 70% of the Meteor's normal (power off) stalling speed.*

The Intruder has five pick-up points for external stores—two under each inner wing and one under the fuselage. According to the makers, the aircraft is able to carry on these five points a greater and more varied amount of stores than any other Naval attack aircraft in existence today. A typical load recently demonstrated on the A2F-1 comprised two Martin ASM-7 Bullpup missiles and three 2,000 lb. Mk. 84 general-purpose bombs.

When extra fuel tanks are carried—as shown in the general arrangement drawing—the Intruder has a very long range capability and exceptional "loiter" ability, all as part of the basic design philosophy. This, in part at least, is an outcome of the Korean War. In Korea, enemy troop movements under the cover of night and inclement weather combined to restrict the effectiveness of aerial support missions, and it was to undertake such missions in a limited "brushfire" war that the Intruder was designed. At the same time, the U.S. Navy wanted an aeroplane able to perform an extended-range, low-altitude nuclear mission.

A design competition, in which eight companies took part with 11 designs, was held between May and December, 1957, to choose the best aeroplane to meet this specification. Grumman's entry was selected on December 31, 1957. The contract for eight Intruders on which Grumman is now working—four for delivery this year and four in 1961—is the first of the "cost-plus-incentive fee" type administered by the U.S. Navy. Valued at just over $101 million, it was awarded to Grumman in March 1959 and allows the company to earn increased profit for bettering performance requirements, for providing accurate and reliable electronic systems and for cutting costs. The first A2F-1 flew in April this year.

Little quantitative data on the Intruder has been published, apart from the following dimensions: Span, 53 ft. (folded, 25 ft. 2 in.); length, 53 ft. 5 in.; height, 15 ft. 1½ in. (folded, 15 ft. 10 in.); tailplane span, 20 ft. 8½ in.; wheel track 10 ft. 10 in. The gross weight is reported to be about 54,000 lb.

* For a full account of these tests, see the paper "Flight Tests with Jet Deflection," by P. F. Ashwood and D. Lean, published in The Journal of the Royal Aeronautical Society for August, 1958.

shown. The air scoop in the small dorsal fin is probably for an artificial feel unit in the control circuit. On this first prototype, the large nose probe is for test instrumentation.

The Fighting Services

Air Rank Promotions

IN the half-yearly promotion list which took effect on Jly. 1, the Air Ministry announced the following air rank promotions.

Air Vice-Marshals A. Earle and S. C. Elworthy have been promoted to the rank of Air Marshal. Air Commodores C. Broughton, C. H. Hartley, S. R. C. Nelson, T. O. Prickett, T. W. Piper and H. B. Wrigley have all been promoted to the rank of Air Vice-Marshal.

Group Captains C. B. E. Burt-Andrews, A. G. P. Brightmore, W. Carter, W. V. Crawford-Compton, I. G. Esplin, C. T. Jackman, J. E. Johnson, R. I. Jones, J. A. Leathart, E. G. L. Millington, B. Robinson and A. W. Smith have been promoted to the rank of Air Commodore. Group Officer A. Stephens, W.R.A.F., has been promoted to the rank of Air Commandant.

Army Air Corps Beavers

THE order for 36 Beavers for the Army Air Corps, which was forecast last December, has now been placed with de Havilland Aircraft of Canada, Ltd., at Toronto. The aircraft will be employed for Army liaison duties and casualty evacuation in the field.

Main components will be manufactured in Canada, then shipped to the United Kingdom for assembly at the de Havilland factory at Chester, where British equipment including radio and instruments will be installed. The first aircraft are expected to be delivered to the Corps at the end of this year.

Visiting Southern Rhodesia

EARLIER this week No. 8 Squadron (Sqn. Ldr. R. Knight) at R.A.F. Khormaksar, was to fly from Aden via Nairobi to Thornhill, Southern Rhodesia, for a goodwill visit to the Royal Rhodesian Air Force. Taking the form of three weeks' flying training at the R.R.A.F. base, the visit follows the one made last November, when No. 1 Squadron, R.R.A.F., spent a period of attachment with the R.A.F. at Khormaksar, where No. 8 was their host squadron.

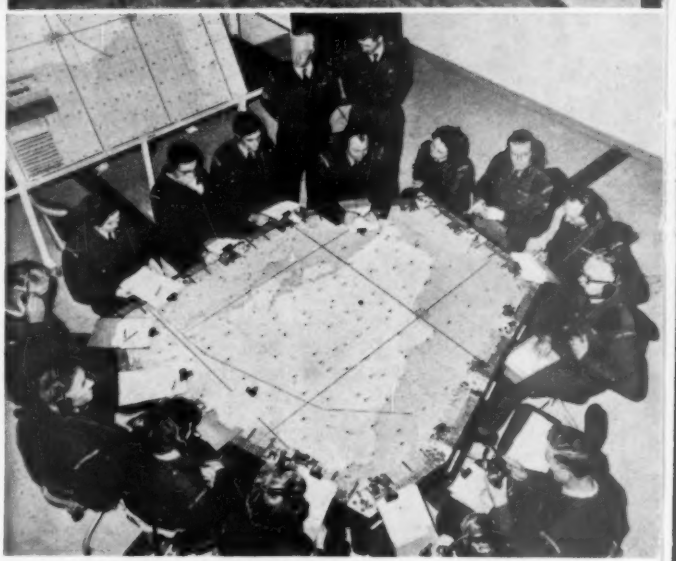
Ground crews who are servicing the Squadron's Hunter FGA.9s during the stay in Southern Rhodesia, were flown to Thornhill in Beverleys and Valettas of No. 84 Squadron.

High-level Descent

LAST week Air Vice-Marshal P. G. Wykenham, D.S.O., O.B.E., D.F.C., A.F.C., Air Officer Commanding, No 38 Group, made his first premeditated parachute drop—from a Twin Pioneer of No. 230 Squadron (Sqn. Ldr. J. West, D.S.O., D.F.C.) off Lyme Regis, Dorset. He was afterwards picked up by R.A.F. air-sea rescue launch.

With the A.O.C. as his guest companion was Brig. N. Crookenden, Commander of the 16th Independent Parachute Brigade Group. Other staff officers joining in the drop included Gp. Capt. C. V. Wynn, D.S.O., O.B.E., the Chief of Staff, and Lt.-Col. M. C. Hall, the Senior Planning Officer.

LANDING ON.—A Westland Wessex flown by Mr. W. H. Sear, the company's chief test pilot, about to land on the flight deck of H.M.S. "Hermes." Made last month, this was the first landing of a Wessex on a carrier.



UNDERGROUND HEADQUARTERS.—The first of a number of underground R.O.C. group headquarters was opened at Maidstone recently. Above, the operations room manned by members of the Corps and, top, the entrance to the headquarters which has a blast-proof and air-tight door.

Having boarded the rescue launch after the drop, Air Vice-Marshal Wykenham changed and then watched a descent from a Hastings of R.A.F. parachute jumping instructors belonging to No. 1 Parachute Training School, followed by Royal Marines and Special Air Service Regiment paratroops. Altogether a total of 30 made the descent.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. G. M. Gibson, M.B.E., and Wg. Cdr. J. A. Hemingway, D.F.C., to the Department of the Air Member for Personnel.

Fighter Command: Gp. Capt. R. F. Watts to R.A.F. Wartling, to command; Wg. Cdr. J. L. Kerr, M.A., to Headquarters as Deputy Senior Personnel Staff Officer; Wg. Cdr. G. T. Thain, D.F.C., to R.A.F. Stradishall, to command the Administrative Wing.

Flying Training Command: Wg. Cdr. R. E. Caesar to Headquarters for engineering duties.

Technical Training Command: Wg. Cdr. A. H. Wilkes, O.B.E., to the R.A.F. Record Office, Gloucester, for work study duties.

Maintenance Command: Wg. Cdr. R. J. Bartlett to Headquarters for air engineering duties; Wg. Cdr. H. A. Chater, A.F.C., to Headquarters for air staff duties.

R.A.F. Germany: Wg. Cdr. C. V. Beadon, D.F.C., to R.A.F. Butzweilerhof, to command.

More Service News

Medical Officer Honoured.—Gp. Capt. R. C. Jackson, M.R.C.S., L.R.C.P., M.R.C.P.(E), has been awarded the Lady Cade Medal for 1960 for his work over the past year in demonstrating the life-saving value to the Service of the artificial kidney. His work at R.A.F. Halton has established that the unit can be used as a life-saving medium in a transportable as well as static rôle.

R.C.N. Trackers.—Seventeen CS2F-1 Trackers of the Royal Canadian Navy are to be transferred to the Netherlands under the Canadian Mutual Aid programme. The CS2F-1 has been replaced as an R.C.N. first-line operational aircraft by the CS2F-2.

First Helicopter Frigate.—The first R.N. frigate designed to carry its own helicopter, the Tribal class "Gurkha," has been launched. Originally mounting Bofors for close-range aircraft defence, the "Gurkha" will have Seacat SAMs later.

To fetch and to carry...

CHOOSE THE AVRO 748

BIRTH OF A SUCCESS STORY

Avro's latest triumph, the 748, represents the climax of intensive effort developing a successor to that veteran jack-of-all-trades, the DC-3. The Avro 748 is robust, simple and cheap to operate. It offers a level of performance and passenger comfort never achieved in any similar aircraft. Capable of operating under the most difficult conditions to be found in any world market, the 748 carries payloads of 44 passengers, or 10,990 lbs. freight. Cruises at 230 knots high above the weather in smooth, pressurised comfort. New minds, new materials and traditional Hawker Siddeley experience and know-how have made the Avro 748 possible.

'.... the cheapest aircraft of its kind on the market'—
The Aeroplane, Sept. 11, 1959.

Two Rolls-Royce Dart Engines

Take-off in 2,520 feet
Wide track undercarriage
Low-pressure tyres
High-efficiency flaps

Operates with ease from high-altitude short and unprepared airstrips.

Fail-safe structure

HAWKER SIDDELEY AVIATION

32 Duke Street, St. James's, London, S.W.1.

THE AVRO 748

IS FITTED WITH

"VOLTABLOC"

("S.A.F.T" PATENT)

Sintered Plate Cadmium Nickel Battery

COMPLETE WITH

"ELCON" DISCONNECT

SUPPLIED BY

CADMIUM NICKEL BATTERIES
LIMITED

SPEDANT WORKS · PARK ROYAL ROAD

LONDON, N.W.10

Avro 748—Feeder-line Transport

RAPID design and construction has been a feature of Avro 748 development; drawing-office work on this feeder-liner began in January, 1959. Although the aircraft's first flight on Jne. 24 came later than originally scheduled, the prototype is fully instrumented for flight tests and the company is confident that A.R.B. certification for airline operation will be received by next April. Whether this is for temperate or all-climate operation will depend on whether tropical trials have been completed before then. Skyways will be the first operator of the aircraft.

It is expected that the handling, development, performance and systems testing needed before the aircraft is certificated will take under 400 flying hours; in addition, route-flying experience will be required by the Air Registration Board before the aircraft receives its airworthiness certificate. It is expected to receive an F.A.A. type certificate at the same time.

The second prototype will fly in November or December. Production aircraft are scheduled at monthly intervals from early in 1961.

Current civil orders for the aircraft cover three for Skyways, two for B.K.S. and three for Aden Airways. Skyways and B.K.S. will have Series 1 aircraft with Rolls-Royce Dart RDa.6 turboprops; the Aden order is for the Series 2 version with the more powerful RDa.7.

On the military side, an agreement has been signed with India for the aircraft to be built under licence for the Indian Air Force. The military transport version differs from the civil aircraft mainly in having a strengthened floor and large freight door. Originally designated the Avro 748M, it is known alternatively as the Avro 757. It will have the Dart RDa.7 and is in effect a military version of the Avro 748 Series 2. All-up weight will be 37,500 lb.

A range of Avro 748 variants is projected. The position at present is that two prototypes of the RDa.6-powered aircraft, the Series 1, are being built. Production versions of the Avro 748 Series 1 will be the Model 101, for Skyways, and Model 102 for B.K.S.

The Avro 748 Series 2 with the Dart RDa.7 has an all-up weight increased from 33,000 to 36,000 lb. The first production version of this type will be the Model 201 for Aden Airways. The prototype Series 2 is scheduled to fly by the middle of next year.

The Avro 748F is a projected civil freighter version of the Series 1 aircraft which would have the freight door and strengthened floor of the Avro 757. Executive models will be known as the Avro 748X.

Another project is for a new high-wing military freighter derived from the Avro 748. This aircraft, the Avro 758, has a new fuselage of increased diameter. Details of this project were published in our issue of Jne. 10.

The Aircraft in Detail

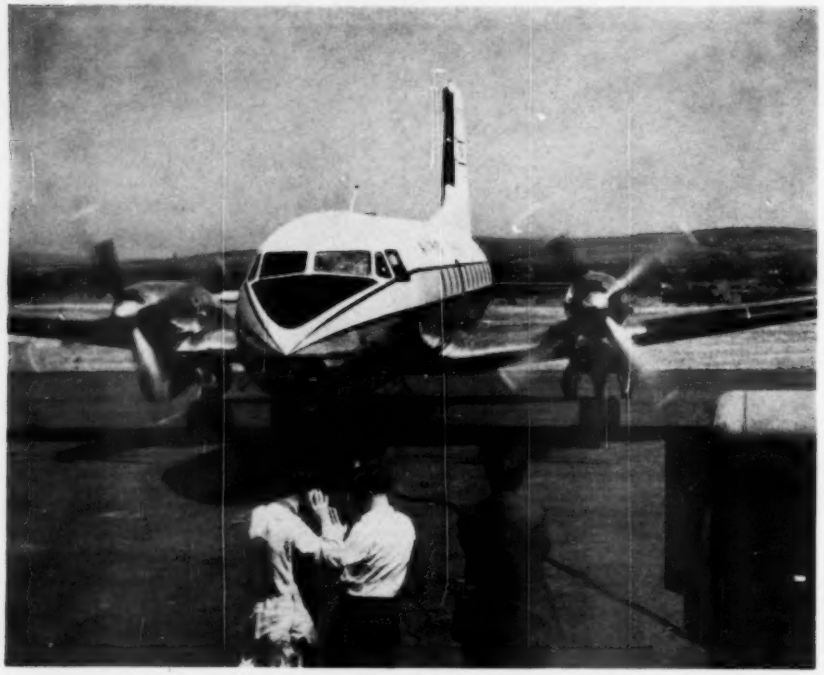
Articles in THE AEROPLANE AND ASTRONAUTICS for Sept. 11, 1959 and Feb. 12, 1960, surveyed the background to the development of the Avro 748 and discussed details of its structural design. In this article it is proposed to concentrate on the aircraft's airframe systems.

Basically the aircraft is an orthodox low-wing monoplane, powered by two Dart turboprops, which is intended for the "Dakota-replacement" market. It can carry up to 44 passengers in a high-density layout of its pressurized cabin.

Structural design of the aircraft has been based on fail-safe principles. This demands good accessibility for inspection, maintenance and repair; and for structural simplicity. The aircraft has been designed to ensure a good fatigue life and none of the high-strength fatigue-prone aluminium alloys has been used.

The structural and fatigue test programme for the airframe is expected to cost over £750,000. A fuselage is now being water-tank tested; repeated applications of cabin pressure have been made representing 10,000 flights involving cruise at 25,000 ft. Following these tests, overloads will be applied to the fuselage and it will then be tested to destruction on a static test rig at Woodford aerodrome. Static structural tests to destruction will also be made on the aircraft's wing and tail unit. A further complete airframe will be fatigue tested, with all take-off, flight, pressurization and landing loads simulated.

In addition to these major tests, a wide range of detail tests have been made on structural components and airframe systems. The philosophy behind the design of systems for the Avro 748



DART RUN-UP.—The scene at Woodford on Jne. 24 prior to the first flight, with the powerplants being given a final check.

Avro 748 . . . .

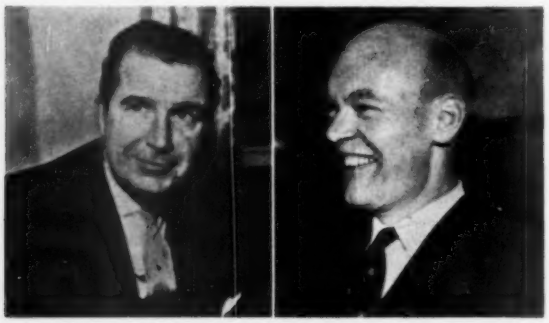
was described in our issue of Sept. 11, 1959. Basically, the aim has been to keep the systems as simple as possible and to make the greatest possible use of proven components, particularly those of the Viscount.

In practice, this has not proved quite as easy as originally hoped, although the basic aims have not changed. In general, alterations have been made as a result of customer needs and of A.R.B. requirements; these are inevitably somewhat stricter now than they were more than 10 years ago when the Viscount was designed. Thus there has been a tendency to make additions which were originally thought unnecessary or to alter some features to meet A.R.B. requirements.

Originally it was expected that Avro 748 sales would be mainly in remote areas but, in fact, most sales to date have been to operators in Britain, apart from the military order for India. In spite of the fact that the Avro 748 is a small low-cost aircraft, there has been a demand for advanced galley, radio and autopilot equipment.

To begin with it was thought that galley space would be needed only for the serving of light refreshments. In fact, there has been a demand for equipment which will allow 44 full meals to be served. In addition, it has been found that airlines make an appreciable income from their sales during flight of high-duty goods such as liquor, scent and cigarettes. A considerable amount of storage space is needed for these.

Typical of the changes in A.R.B. requirements is the need for the engine auxiliary-drive gearbox, generators and hydraulic pumps to be enclosed to form a fire zone.



AVRO PERSONALITIES.—Leaders of the Avro team include, left, Mr. J. A. R. Kay, the managing director and, right, Mr. J. R. Ewans, executive director and chief designer.

Powerplant

As already mentioned, the Avro 748 Series 1 is powered by two Rolls-Royce Dart RDa.6 Mk. 514 turboprop engines. This version of the Dart is similar to the Mk. 510 installed in 800-series Viscounts; the main difference is a change in the reduction gearing to give an 0.0862 : 1 ratio. This has been done to keep the tip speed of the Avro 748's propellers no higher than on the Viscount, although their diameter is 12 ft. compared with 10 ft. 6 in. on the latter aircraft. The Dowty

(*Continued on back of pullout*)

Left to right: Mr. R. Connor, project designer for the Avro 748; Mr. J. Rimmington, the chief development engineer; Sqn. Ldr. J. G. Harrison, the company's chief test pilot who took the aircraft on its first flight; Mr. C. Allen, the co-pilot on that occasion; and Prince Emmanuel Galitzine, Avro's sales manager and in charge of the 748 sales drive.

AVRO 748 Series 1 Feeder-li

Two 1,740 e.h.p. Rolls-Royce Dart RDa.6 Mk.514 Turboprop Engines

KEY

Fuselage and Tailplane

1. Fabricated nose cone.
2. Batteries.
3. Front pressure bulkhead.
4. Nose-wheel bay fail-safe bracing.
5. Pressure floor.
6. Crew-compartment floor.
7. Window coaming.
8. Crew-compartment bulkhead.
9. Freight-door frame structure.
10. Upward-opening freight and crew door.
11. Freight compartment.
12. Floor support structure.
13. Diagonal floor bracing.
14. Front-spar frame.
15. Rear-spar frame.
16. Centre-section rib fail-safe bracing.
17. Fuselage side rib.
18. Continuous fuselage stringers.
19. Pressure-floor continuous wing stringers.
20. Over-wing emergency-exit structure.
21. Cabin window structure.
22. Cloak compartment.
23. Typical 40-seat layout.
24. Galley.
25. Rear baggage door (on starboard side).
26. Baggage compartment.
27. Toilet.
28. Rear passenger door.
29. Rear pressure bulkhead.
30. Fin mounting to tailplane torsion box.
31. Tailplane torsion-box rib structure.
32. Tailplane root-rib fail-safe structure.
33. Fin and tailplane access panels.
34. Fin front spar.

Wing

35. Wing front spar.
36. Spar-to-frame mounting.
37. Water methanol tank in wing fillet.
38. Wing lower-surface stringer ties.
39. Flap track cantilevered off rear spar.
40. Reinforced ribs for powerplant and landing-gear attachment.
41. Main landing gear, forward retracting.
42. Forward wheel doors—closed when wheels are fully extended or retracted.
43. Rear undercarriage doors.
44. Inboard bulkhead rib of integral fuel tank.
45. Wing-rib fail-safe bracing.
46. Tank baffle rib.
47. Underwing access panel.
48. Detachable leading-edge with pneumatic de-icing (outboard of powerplants).
48A. Hinged leading-edge gives access to air-conditioning system silencers.
49. Pneumatic de-icing.
50. Powerplant bearers cantilevered from wing structure.
51. Fireproof nacelle bulkhead.
52. Hinged cowlings.
53. Outboard tank end rib.

Powerplant

54. Oil cooler.
55. Oil-cooler air outlet.
56. Accessory-drive gearbox.
57. 6-kW. generator.
58. Synchronizing alternator.
59. Hydraulic pump.
60. 22 kVA. alternator.
61. Cabin-air blower.
62. Spill-valve outlet.
63. Jet-pipe cooling-air inlet.
64. Generator cooling-air inlet.
65. Throttle control quadrant.
65A. High-pressure fuel-cock control quadrant.
66. Jet-pipe shroud.
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69. Cooling air inlet, zone 1 and 2.
70. Exhaust cooling-air inlet for ground running.
71. Oil-cooler air-inlet.
72. Engine-oil dipstick access.
73. Grouped throttle and high-pressure cock controls in cockpit.
73A. Ground-running pitch-control lever.
74. Powerplant control cables carried in floor structure.

Ailerons

75. Aileron cables in floor structure.
75A. Aileron trim wheel.
76. Aileron quadrant.
77. Tie rods running on port side.
78. Quadrant mounted on rear spar (see starboard wing).
79. Tie rods.
80. Cables.
80A. Aileron trim-tab control.

Rudder

81. Rudder pedals with toe brakes.
82. Coupling rod to starboard pedals thence to quadrant and cables out starboard side.
83. Tension-regulator quadrant (in tailplane torsion box).
84. Trim-tab cable.
85. Rudder trim wheel (in cockpit).
85A. Control-lock lever.

Elevators

86. Control-column torque-tube interconnection.
86A. Elevator trim wheel.
87. Push-pull rod to quadrant.
88. Tie rods beneath floor on port side (by rear pressure bulkhead).
89. Tension-regulator quadrant assembly (in tailplane torsion box).
90. Push-pull rod to bell-crank lever.

Flaps

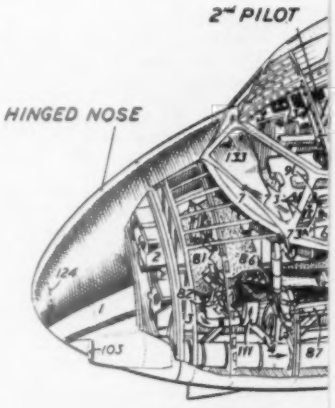
91. Flap control lever—four-position gate.
92. Flap drive motor and gearbox in port wing fillet only.
93. Chain drive between torque shafts.
94. Flexible couplings.
95. Dual torque shafts to rib 46.
96. Single torque shaft outboard of rib 46.
97. Dual torque shafts and Hookes couplings to starboard flaps (see wing root).
98. Flap-track fairing.
99. Cable drum at flap tracks.
100. Flap roller carriage.
101. Tab-flap operating lever.
102. Tab flaps run full length of main flap.

Air Conditioning and Pressurization

103. Inlet for ram cooling air in fuselage nose.
104. Air duct.
105. Cold-air unit.
106. Primary cooler.
107. Secondary cooler.
108. Main cabin air duct.
109. Duct to crew compartment.
110. Crew-compartment roof outlets.
111. Air conditioning to crew compartment.
112. Temperature control valve.
113. Choke valve.
114. Metering duct.
115. Silencer—one in each inboard leading-edge of wing.
116. Non-return valve.
117. Cabin-blower air inlet in nacelle.
118. Spill valve.
119. Cabin pressurization feed.
120. Cabin-air duct. Air enters through cabin wall and discharges through amenity panels.
121. Duct to rear compartments.
122. Air outlet to discharge valves.
123. Safety valve in rear pressure bulkhead.

Radio

124. Glide-slope aerial in fuselage nose.
125. VHF communications aerial.
126. ADF loop aerial.
127. ILS/VOR localizer aerial to tip of fin.
128. Ice-detection lamp in nacelle side.
129. Starboard navigation lamp.
130. Anti-collision beacon at tip of fin.
131. VHF radio crate and auto-pilot.
132. Starboard AC/DC distribution box.
133. Stand-by compass.
134. Starboard console with intercomm. controls.

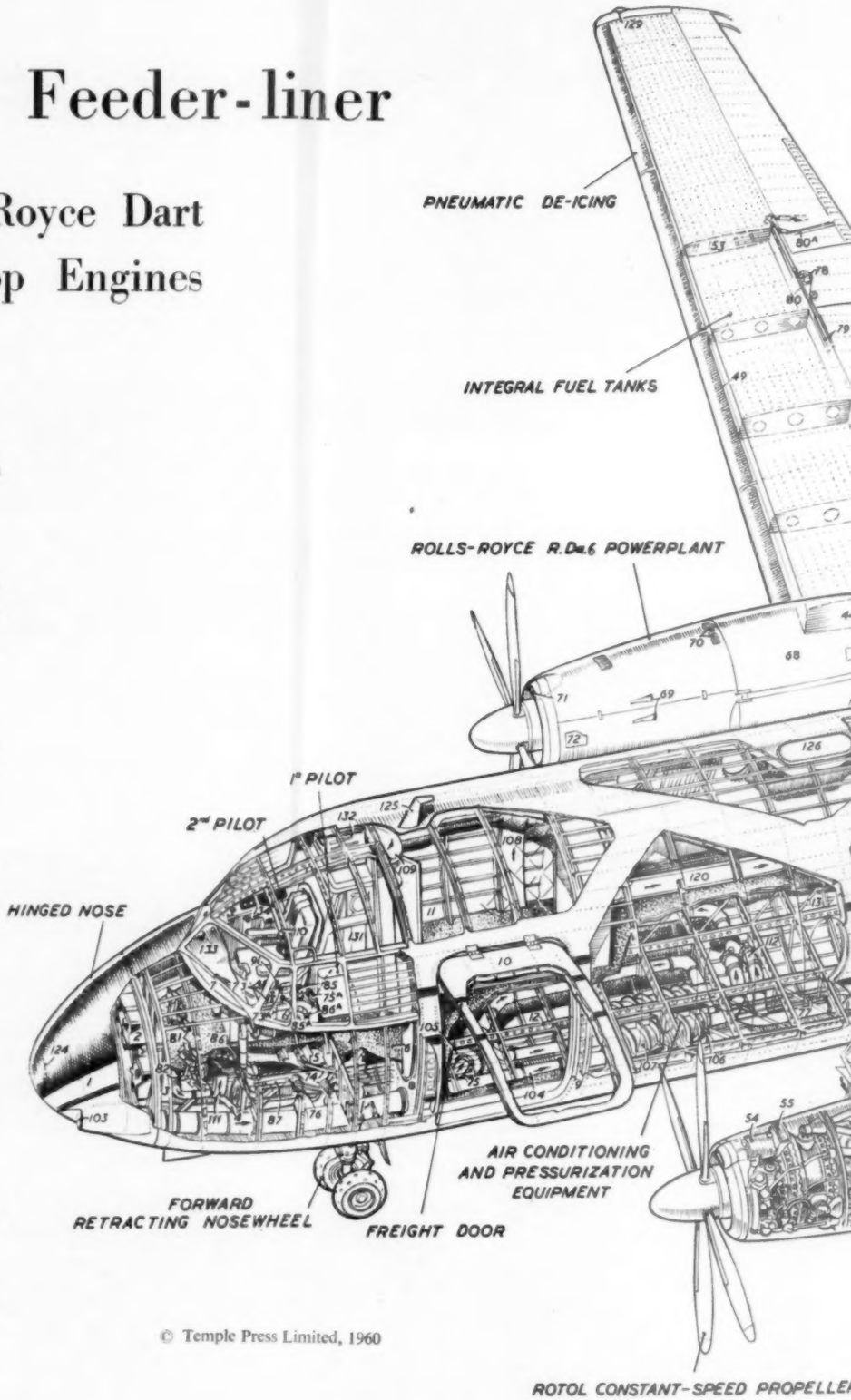


FORWARD RETRACTING NOSEWHE

© Temple Press

AVRO 748 Series 1 Feeder-liner

Two 1,740 e.h.p. Rolls-Royce Dart RDa.6 Mk.514 Turboprop Engines



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88. Tie rods beneath floor on port side (by rear pressure bulkhead).
89. Tension-regulator quadrant assembly (in tailplane torsion box).
90. Push-pull rod to bell-crank lever.

Flaps

91. Flap control lever—four-position gate.
92. Flap drive motor and gearbox in port wing fillet only.
93. Chain drive between torque shafts.
94. Flexible couplings.
95. Dual torque shafts to rib 46.
96. Single torque shaft outboard of rib 46.
97. Dual torque shafts and Hookes couplings to starboard flaps (see wing root).
98. Flap-track fairing.
99. Cable drum at flap tracks.
100. Flap roller carriage.
101. Tab-flap operating lever.
102. Tab flaps run full length of main flap.

Air Conditioning and Pressurization

103. Inlet for ram cooling air in fuselage nose.
104. Air duct.
105. Cold-air unit.
106. Primary cooler.
107. Secondary cooler.
108. Main cabin air duct.
109. Duct to crew compartment.
110. Crew-compartment roof outlets.
111. Air conditioning to crew compartment.
112. Temperature control valve.
113. Choke valve.
114. Metering duct.
115. Silencer—one in each inboard leading-edge of wing.
116. Non-return valve.
117. Cabin-blower air inlet in nacelle.
118. Spill valve.
119. Cabin pressurization feed.
120. Cabin-air duct. Air enters through cabin wall and discharges through amenity panels.
121. Duct to rear compartments.
122. Air outlet to discharge valves.
123. Safety valve in rear pressure bulkhead.

Radio

124. Glide-slope aerial in fuselage nose.
125. VHF communications aerial.
126. ADF loop aerial.
127. ILS/VOR localizer aerial to tip of fin.
128. Ice-detection lamp in nacelle side.
129. Starboard navigation lamp.
130. Anti-collision beacon at tip of fin.
131. VHF radio crate and auto-pilot.
132. Starboard AC/DC distribution box.
133. Stand-by compass.
134. Starboard console with intercomm. controls.

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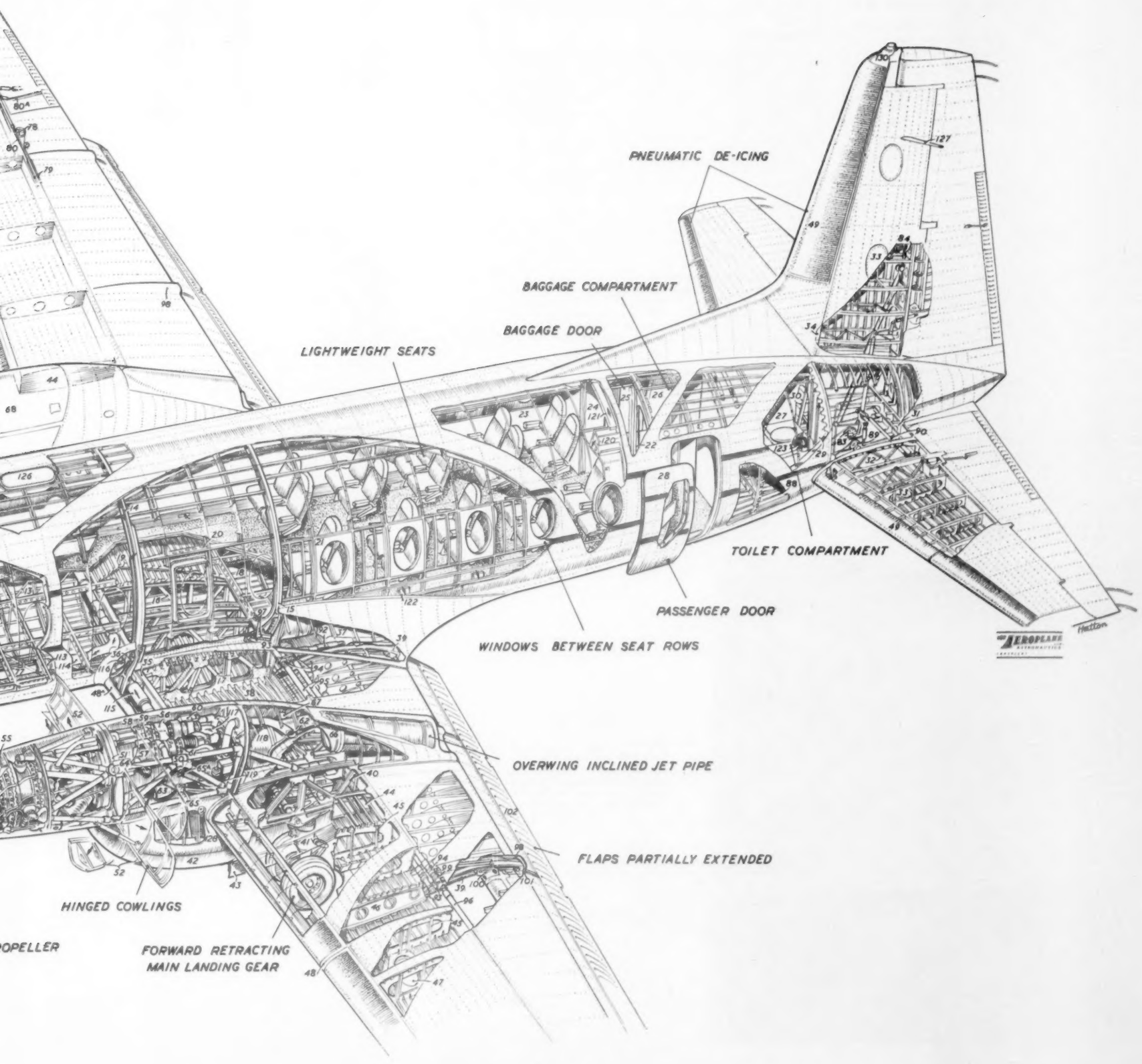
PNEUMATIC DE-ICING
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LIGHTWEIGHT SEATS
TOILET COMPARTMENT
PASSENGER DOOR
WINDOWS BETWEEN SEAT ROWS
OVERWING INCLINED JET PIPE
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HINGED COWLINGS
FORWARD RETRACTING
MAIN LANDING GEAR
OPELLER
Hatton

Rotol propellers of the Avro 748 are similar to those of the Friendship and Argosy.

Although the Avro 748 propeller has such a large diameter there is a 2-ft. clearance between the propeller tips and the ground, and between the tips and the fuselage side; both these dimensions are greater than those on the Viscount. This requirement for ground clearance helped decide the nacelle position of the Avro 748. Other needs which dictated its location were that the fail-safe structure of the wing should not be jeopardized by the engine installation; that the jet-pipe should pass over the wing; and that the undercarriage should not enter the wing torsion box.

Engine cowlings and mountings are bought by Avro from Vickers. The cowlings are the same as those on Viscount 800 inboard engines.

The engine auxiliary-drive gearbox and major auxiliaries are in a fireproof bay in the upper part of the nacelle behind each engine. Each engine drives a 22-kVA. three-phase alternator, a 6-kW. 28-V. DC generator, a Godfrey cabin blower, a Mk. 9 Lockheed hydraulic pump and a tachometer generator. An engine-synchronizing alternator can also be installed if required.

Fuel System

There is a 570-Imp.-gal. integral fuel tank in each wing outboard of the engine. Fuel is supplied by gravity to a collector tank mounted in the torsion box inboard of each engine; from this, two electrically driven fuel pumps supply the engine. Each pump can supply the maximum engine demand.

A cross feed between the collector tanks is provided so that each fuel tank can supply either or both engines. Two of the four fuel pumps can fail without restricting the flow of fuel to the engines. The capacity of the fuel system could be increased by extending the tanks outboard along the wing or by the introduction of tip or underwing tanks.

Pressure refuelling is standard on the Avro 748, but the aircraft can also be gravity fuelled. There is a Smiths Waymouth fuel-gauge system and in addition, for refuelling, there is an Avro-designed drip-stick system. These indicator sticks can be unscrewed from under the wing and lowered until fuel drips from them, when the volume of fuel in the tank can be read from calibrations on the stick.

The aircraft has two water-methanol tanks which are in the wing trailing-edge fillets. They are bag tanks; each holds approximately 33 Imp. gal. and has an electrically driven pump which normally feeds the engine in its wing. A cross-feed system with cocks manually operated from the crew compartment allows the tanks to supply either engine. Float gauges indicate the amount of water-methanol in each tank.

Fire-protection

A Graviner fire-protection system is installed and each power-plant and nacelle is divided into four zones. The first stretches from the propeller to the rear of the compressor casing; the second from there to the engine firewall; the third is round the jet-pipe shroud and main wheel bay; and the fourth contains the auxiliary drive gearbox and the engine-driven components of the electrical and hydraulic systems. Fire extinguishant is provided for the first, second and fourth of these zones.

There is a Firewire indicator system and two 12-lb. bottles of methyl bromide extinguishant, one in each nacelle, with a cross-feed giving two-shot protection. The indicator system gives independent warning of nacelle fires and of engine overheating.

In the past, engine overheating has on occasion led to fruitless use of the extinguisher system following which, the engine fire has broken into the nacelle after the methyl bromide has been discharged. With the system on the Avro 748 an indicator in the engine oil-breather pipe gives a warning if the engine overheats; it can then be shut down without discharging the methyl bromide; which is in reserve to deal with a nacelle fire.

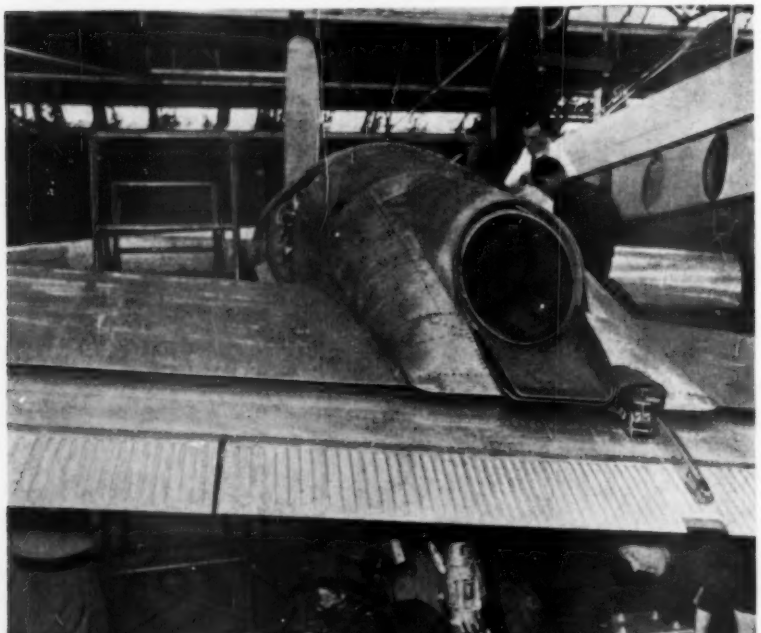
A second engine-overheat warning will also be installed in future to give a warning if cooling air from the turbine bearing is overheated. Thus there will be three warning systems, two of which will require the engine to be shut down without the discharge of the methyl bromide; this will be available if a nacelle fire follows.

Hydraulics

Lockheed components are used almost exclusively in the hydraulic system; most are of the type installed on the Viscount. The hydraulic fluid used is DTD585; Avro has considered the use of fire-resistant fluids, but they would only be used if specifically requested.

Undercarriage retraction, braking and nosewheel steering are hydraulic. In addition, Avro 748 operators may have an hydraulic propeller-brake to special order. The two engine-driven hydraulic pumps are supplied with fluid from a reservoir in the starboard undercarriage bay. They deliver fluid at 2,500 p.s.i. to the services and to the main hydraulic accumulator. Stainless-steel hydraulic lines are used on the H.P. side and for pipes passing through fire zones.

The brakes on the inner and outer of the paired main under-



JET-PIPE.—Engine jet-pipes of the Avro 748 pass over the wing. In this view can be seen the trailing-edge tab flap which is lowered to a greater angle than the flap itself to increase drag during the landing approach.

Photographs copyright "The Aeroplane and Astronautics"

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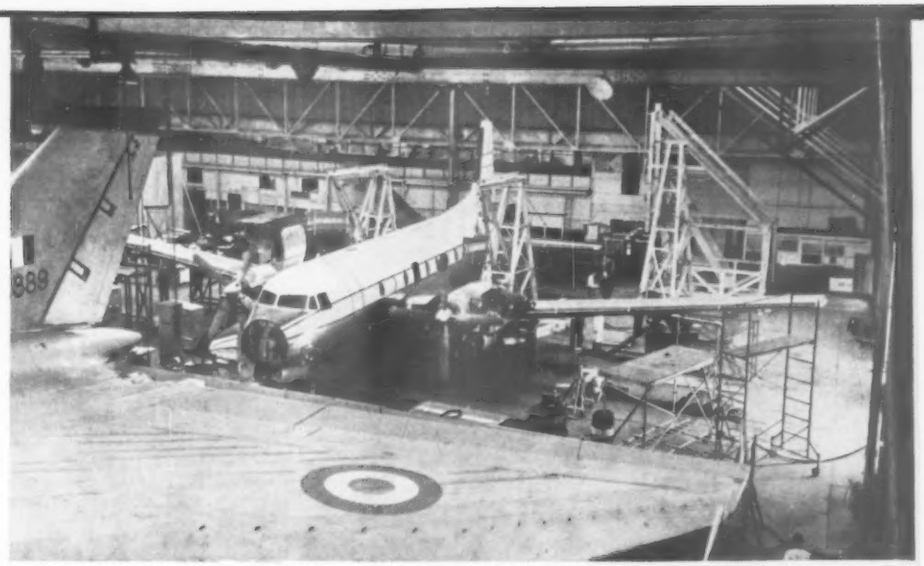

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there is a separate hydraulic accumulator for the inner
outer wheels. Thus a single hydraulic failure would still
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prototypes. Dunlop wheels, tyres and brakes are fitted
ll as Maxaret anti-skid units.

three units of the aircraft's British Messier undercarriage
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l to the legs. The self-centring nosewheel can be steered
gh 45° either side of central.

emergency use a handpump delivers fluid to the main
ulic system. For emergency lowering of the undercarriage
is a selector which mechanically releases the up-locks;
this the undercarriage should fall freely, aided by the air
on it, and lock down. But to ensure lowering of the
carriage there is a separate set of hydraulic-fluid delivery
leading from the handpump direct to the undercarriage
When the undercarriage emergency control is selected
ndpump can be used to supply hydraulic fluid direct to
ndercarriage jacks rather than to supply the hydraulic
n as a whole. It can also top up the wheel brake systems.

ical Systems

aircraft has three electrical systems, which supply
ctively the airframe services, radio and instruments, and
g circuits. The basic system is 28V DC single-wire earth-
supplied by a 6-kW generator on each engine. It pro-
power for flap operation, lighting and galley supplies, as
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nor-controlled carbon pile. Switching is arranged so that
nverter can carry any load in the 115V system.

in fuse and circuit-breaker panels of the electrical system
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at leaving their seats. In addition to the normal naviga-
ights, the aircraft has a rotating anti-collision beacon
on the top of its fin and icing-inspection lights which
along the wing leading-edge.

rization

Avro 748 has a direct supply pressurization system with-
circulation of cabin air. Cabin pressure differential is
.i. on the Series 1 aircraft and 5.5 p.s.i. on the Series 2.

under pressure is supplied by Godfrey cabin blowers,
riven by each engine, which draw in air via filters on the
of the engine nacelles. The air then passes through
ers and via non-return valves at the fuselage side into
selage. It passes through a flow controller and choke
which is manually controlled from the cockpit and can
pass either direct to the cabin if the greatest possible
g is required. If not, part or all of the supply is passed through a ram-air heat exchanger before mixing with the rest of the air from the blowers, if any, and entering the cabin.

The heat exchanger is supplied with cooling air from a ram intake on the port side of the aircraft's nose; after passing through the heat exchanger this air is ducted overboard. Feeding into this exhaust is the cabin pressure-release duct which is controlled from the cockpit by a manually operated dump valve.

After mixing to give the correct temperature, the cabin air passes up from the floor via the main supply duct and then forward and aft along the fuselage. There are separate supply ducts for the pilots, for cooling radio equipment, and for the passengers. After circulation through the cabin the air passes through floor-level louvres and overboard via two discharge valves located in the toilet compartment.

Cabin pressure is regulated by a Normalair pressure controller. A spill valve can be electrically operated from the crew compartment to override the pressure regulator if this is necessary; there is a safety valve on the rear pressure bulkhead. To prevent cabin air from becoming contaminated by hydraulic fluid the hydraulic lines are contained in a mist-proof duct under the floor which is vented overboard.

Although not a standard installation on the basic aircraft, additional cooling can be provided in the system by the addition of a further heat exchanger—a cold-air unit of the type used on the Viscount—and a water extractor.

A special ditching control is installed to prevent water entering the cabin after the aircraft has ditched. This mechanically closes the main intake and discharge valves.

Ice Protection

Airframe de-icing is optional on the Avro 748 and is not installed on the standard aircraft. The Goodrich inflatable pneumatic boot system is used, with boots which inflate in spanwise strips on the wing tip and fin, and chordwise on the wing and tailplane leading-edges. Compressed air is tapped from the engine compressors to inflate the boots, which break up any ice formation mechanically. When the boots are not in use compressed air is passed through an extractor to provide a suction which holds the boots against the aerofoil profile; this is necessary because aerodynamic suction tends to lift them from the surface.

On each wing leading-edge the boots are in four sections; the leading-edge between the nacelles and fuselage is not de-iced. A cyclic timer inflates the boots in a predetermined sequence, as well as inflating alternate tubes in each boot. A heavy or a light icing cycle can be selected, taking one or four minutes respectively. The operating pressure is 18 p.s.i.

This system has been proved by flight tests with the Napier icing-research Lincoln in which a section of the Avro 748 wing was mounted above its fuselage. Chordwise tubes had been chosen because they gave a neater installation with less drag than the spanwise type used in the past; Napier tests, however, showed that the chordwise type were not as effective on thin aerofoil sections and thus spanwise tubes are to be installed on the fin and wing tip of the Avro 748.

The front windscreen panels and direct-vision screens are electrically de-iced by the Triplex gold-film technique, and a glycol spray can also be fitted, if required, by the operator. Electrical de-icing of the propeller and engine air intake is by the same cyclic system as used on the Viscount.

	Series 1	Series 2
Powerplant	2x Rolls-Royce Dart RDa. 6, Mk. 514	2x Rolls-Royce Dart RDa. 7, Mk. 529
Take-off power, per engine ..	1,740 e.h.p. at 14,500 r.p.m.	2,105 e.h.p. at 15,000 r.p.m.
Weights		
Basic operational	19,444 lb.	20,344 lb.
Total fuel load	8,800 lb.	8,800 lb.
Manufacturer's max. payload ..	9,666 lb.	9,666 lb.
Max. take-off	33,000 lb.	36,000 lb.
Max. landing	33,000 lb.	35,500 lb.
Max. zero-fuel	29,110 lb.	30,010 lb.
Performance		
Take-off field length, sea-level at ISA + 15°C.	3,750 ft.	3,780 ft.
Cruising speed at altitude ..	230 kt., 20,000 ft.	252 kt. 25,000 ft.
Weight and fuel consumption	31,000 lb., 156 gal./hr.	34,000 lb., 156 gal./hr.
Range (take-off to landing) with max. payload, no reserves	585 n.m.	1,050 n.m.
Range (take-off to landing) and payload with max. fuel, no reserves	1,565 n.m. 4,436 lb.	1,695 n.m. 6,581 lb.
Approach speed	92 kt.	94 kt.
Landing field length required	2,190 ft.	2,325 ft.

Control System

The Avro 748 has manually operated dual controls. Elevators and ailerons have set-back hinges and the rudder is horn balanced. There is a geared tab on each aileron and a trim tab on one. Elevators have geared tabs and trim tabs, and the rudder has spring and trim tabs. Controls are cable operated with tension regulators in the circuits.

The electrically operated Fowler flaps have an additional tab flap at the trailing-edge to increase drag during the landing approach. Electrical operation was chosen to ensure a fail-safe system in which the flaps remained locked if there is any failure in their operating mechanism. Fail-safe features have also been incorporated in the design of the flap attachments and support structure.

Drive to the flaps is via a "ring main" of torque tubes, this feature, coupled with irreversibility of the drive gearbox, ensures that if a failure occurs the flaps will not move from a selected position either together or asymmetrically under the influence of air loads.

Each flap is 28 ft. long and has four track stations along it. At each of these tracks the flap is moved by cables from drums on the torque shaft. The whole flap system is driven by a single electric motor; there is an emergency handle in the fuselage.

Flight Deck

The aircraft is intended for operation by a crew of two pilots, but there is space for a radio operator's station if this is required by operators. Each pilot has a full blind-flying panel. Engine and fuel controls and trimmers are on a console between the pilots. All the main engine instruments are mounted between the blind-flying panels. Above there is an emergency panel with all the appropriate indicators and switches.

On the first pilot's side console is the nosewheel steering control, interphone and jackboxes, oxygen selector and Sperry Gyrosyn compass control. The second pilot's side console carries the pressurization controls and oxygen and interphone

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AVRO 748 SUPP

The following list of suppliers for the Avro 748 feeder-liner has been provided by A. V. Roe and Co., Ltd.:—

Aerocontacts, Ltd.; Aero Controls, Ltd.; Aeroxalley, Ltd.; Aircraft Furnishings, Ltd.; Aircraft-Marine Products (Gt. Britain), Ltd.; Airmed, Ltd.; Amphenol (Gt. Britain), Ltd.; Amplivox, Ltd.; George Angus and Co., Ltd.; Associated Electrical Industries (Rugby), Ltd.; Automotive Products Co., Ltd.; Avica Equipment, Ltd.; Avimo, Ltd.; Aviquipo of Britain, Ltd.; Beaufort (Air Sea) Equipment, Ltd.; Belling and Lee, Ltd.; Bell's Asbestos and Engineering, Ltd.; Bendix Radio Div.; Besson and Robinson, Ltd.; The Birmingham Guild, Ltd.; British Electric Resistance Co., Ltd.; British Insulated Callender's Cables, Ltd.; British Messier, Ltd.; The British Refrasil Co., Ltd.; British Tyre and Rubber Co., Ltd.; S. G. Brown, Ltd.; Brunton's (Musselburgh), Ltd.; Budenberg Gauge Co., Ltd.;

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allows the tanks to supply either engine. Float gauges indicate the amount of water-methanol in each tank.

Fire-protection

A Graviner fire-protection system is installed and each power-plant and nacelle is divided into four zones. The first stretches from the propeller to the rear of the compressor casing; the second from there to the engine firewall; the third is round the jet-pipe shroud and main wheel bay; and the fourth contains the auxiliary drive gearbox and the engine-driven components of the electrical and hydraulic systems. Fire extinguishant is provided for the first, second and fourth of these zones.

There is a Firewire indicator system and two 12-lb. bottles of methyl bromide extinguishant, one in each nacelle, with a cross-feed giving two-shot protection. The indicator system gives independent warning of nacelle fires and of engine overheating.

In the past, engine overheating has on occasion led to fruitless use of the extinguisher system following which, the engine fire has broken into the nacelle after the methyl bromide has been discharged. With the system on the Avro 748 an indicator in the engine oil-breather pipe gives a warning if the engine overheats; it can then be shut down without discharging the methyl bromide; which is in reserve to deal with a nacelle fire.

A second engine-overheat warning will also be installed in future to give a warning if cooling air from the turbine bearing is overheated. Thus there will be three warning systems, two of which will require the engine to be shut down without the discharge of the methyl bromide; this will be available if a nacelle fire follows.

Hydraulics

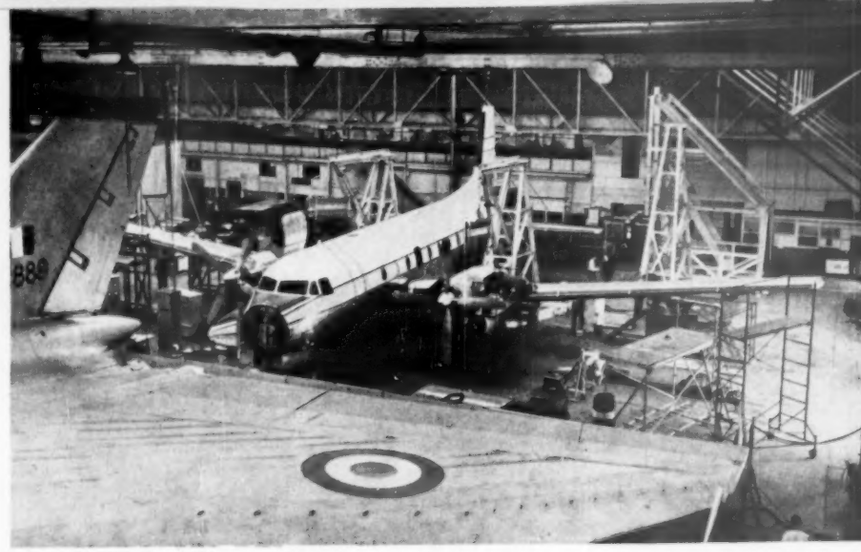
Lockheed components are used almost exclusively in the hydraulic system; most are of the type installed on the Viscount. The hydraulic fluid used is DTD585; Avro has considered the use of fire-resistant fluids, but they would only be used if specifically requested.

Undercarriage retraction, braking and nosewheel steering are hydraulic. In addition, Avro 748 operators may have an hydraulic propeller-brake to special order. The two engine-driven hydraulic pumps are supplied with fluid from a reservoir in the starboard undercarriage bay. They deliver fluid at 2,500 p.s.i. to the services and to the main hydraulic accumulator. Stainless-steel hydraulic lines are used on the H.P. side and for pipes passing through fire zones.

The brakes on the inner and outer of the paired main undercarriage wheels are supplied from independent hydraulic systems; there is a separate hydraulic accumulator for the inner and outer wheels. Thus a single hydraulic failure would still allow symmetrical braking of the aircraft. Anti-skid units can be installed if required by operators; they are installed on both prototypes. Dunlop wheels, tyres and brakes are fitted as well as Maxaret anti-skid units.

All three units of the aircraft's British Messier undercarriage retract forward; the undercarriage doors are mechanically linked to the legs. The self-centring nosewheel can be steered through 45° either side of central.

For emergency use a handpump delivers fluid to the main hydraulic system. For emergency lowering of the undercarriage there is a selector which mechanically releases the up-locks; after this the undercarriage should fall freely, aided by the air loads on it, and lock down. But to ensure lowering of the undercarriage there is a separate set of hydraulic-fluid delivery lines leading from the handpump direct to the undercarriage jacks. When the undercarriage emergency control is selected the handpump can be used to supply hydraulic fluid direct to the undercarriage jacks rather than to supply the hydraulic system as a whole. It can also top up the wheel brake systems.



FINAL ASSEMBLY.—Overshadowed by a Vulcan, the prototype Avro 748 in the flight hangar at Woodford aerodrome.

Electrical Systems

The aircraft has three electrical systems, which supply respectively the airframe services, radio and instruments, and de-icing circuits. The basic system is 28V DC single-wire earth-return supplied by a 6-kW generator on each engine. It provides power for flap operation, lighting and galley supplies, as well as for the 115V three-phase 400-cycle system for radio and instruments; current for this is inverted from the 28V supply.

Power for de-icing the propellers, engine air intakes and windscreen panels is supplied by an alternator on each engine. The alternators provide 200V three-phase variable-frequency current.

Two 24V 23-amp.-hr. nickel-cadmium batteries are mounted in the nose cone ahead of the front pressure bulkhead. Space is available for two more of these batteries, which are installed if engines are to be started without drawing on an external power supply. In practice this feature is required by most operators.

Two inverters are installed and a third is carried if an auto-pilot is required. Their output is maintained at 115V±2½% by a carbon pile; frequency is kept at 400 cycles±5% by a governor-controlled carbon pile. Switching is arranged so that any inverter can carry any load in the 115V system.

Main fuse and circuit-breaker panels of the electrical system are mounted above and behind the pilots, who can reach them without leaving their seats. In addition to the normal navigation lights, the aircraft has a rotating anti-collision beacon light on the top of its fin and icing-inspection lights which shine along the wing leading-edge.

Pressurization

The Avro 748 has a direct supply pressurization system without recirculation of cabin air. Cabin pressure differential is 4.2 p.s.i. on the Series 1 aircraft and 5.5 p.s.i. on the Series 2.

Air under pressure is supplied by Godfrey cabin blowers, one driven by each engine, which draw in air via filters on the sides of the engine nacelles. The air then passes through silencers and via non-return valves at the fuselage side into the fuselage. It passes through a flow controller and choke valve which is manually controlled from the cockpit and can then pass either direct to the cabin if the greatest possible heating is required. If not, part or all of the supply is passed through a ram-air heat exchanger before mixing with the re of the air from the blowers, if any, and entering the cabin.

The heat exchanger is supplied with cooling air from a ra intake on the port side of the aircraft's nose; after passin through the heat exchanger this air is ducted overboard. Feed ing into this exhaust is the cabin pressure-release duct whic is controlled from the cockpit by a manually operated dum valve.

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Manufacturer's max. payload	9,666 lb.	9,666 lb.
Max. take-off	33,000 lb.	36,000 lb.
Max. landing	33,000 lb.	35,500 lb.
Max. zero-fuel	29,110 lb.	30,010 lb.
Performance		
Take-off field length, sea-level at ISA + 15°C.	3,750 ft.	3,780 ft.
Cruising speed at altitude	230 kt., 20,000 ft.	252 kt. 25,000 ft.
Weight and fuel consumption	31,000 lb., 156 gal./hr.	34,000 lb., 156 gal./hr.
Range (take-off to landing) with max. payload, no reserves	585 n.m.	1,050 n.m.
Range (take-off to landing) and payload with max. fuel, no reserves	1,565 n.m.	1,695 n.m.
	4,436 lb.	6,581 lb.
Approach speed	92 kt.	94 kt.
Landing field length required	2,190 ft.	2,325 ft.

JET-PIPE.—Engine jet-pipes of the Avro 748 pass over the wing. In this view can be seen the trailing-edge tab flap which is lowered to a greater angle than the flap itself to increase drag during the landing approach.

Photographs copyright "The Aeroplane and Astronautics"

a suction which holds the boots against the aerofoil profile; this is necessary because aerodynamic suction tends to lift them from the surface.

On each wing leading-edge the boots are in four sections; the leading-edge between the nacelles and fuselage is not de-iced. A cyclic timer inflates the boots in a predetermined sequence, as well as inflating alternate tubes in each boot. A heavy or a light icing cycle can be selected, taking one or four minutes respectively. The operating pressure is 18 p.s.i.

This system has been proved by flight tests with the Napier icing-research Lincoln in which a section of the Avro 748 wing was mounted above its fuselage. Chordwise tubes had been chosen because they gave a neater installation with less drag than the spanwise type used in the past; Napier tests, however, showed that the chordwise type were not as effective on thin aerofoil sections and thus spanwise tubes are to be installed on the fin and wing tip of the Avro 748.

The front windscreen panels and direct-vision screens are electrically de-iced by the Triplex gold-film technique, and a glycol spray can also be fitted, if required, by the operator. Electrical de-icing of the propeller and engine air intake is by the same cyclic system as used on the Viscount.

Control System

The Avro 748 has manually operated dual controls. Elevators and ailerons have set-back hinges and the rudder is horn balanced. There is a geared tab on each aileron and a trim tab on one. Elevators have geared tabs and trim tabs, and the rudder has spring and trim tabs. Controls are cable operated with tension regulators in the circuits.

The electrically operated Fowler flaps have an additional tab flap at the trailing-edge to increase drag during the landing approach. Electrical operation was chosen to ensure a fail-safe system in which the flaps remained locked if there is any failure in their operating mechanism. Fail-safe features have also been incorporated in the design of the flap attachments and support structure.

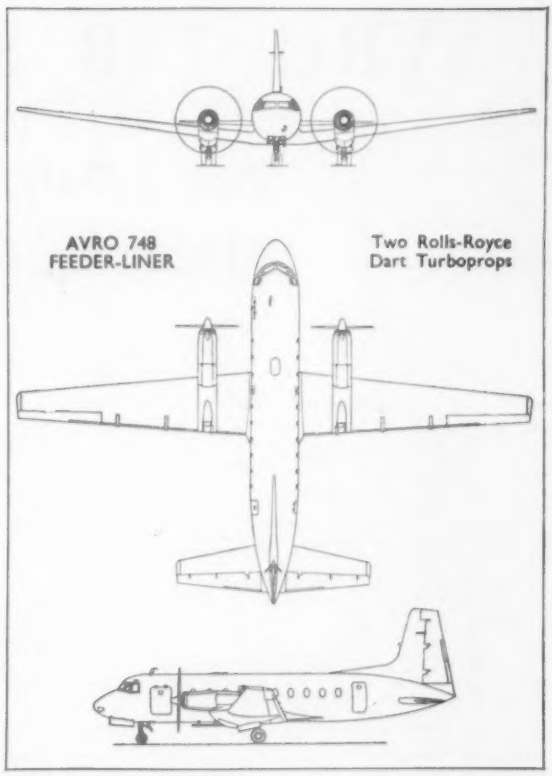
Drive to the flaps is via a "ring main" of torque tubes, this feature, coupled with irreversibility of the drive gearbox, ensures that if a failure occurs the flaps will not move from a selected position either together or asymmetrically under the influence of air loads.

Each flap is 28 ft. long and has four track stations along it. At each of these tracks the flap is moved by cables from drums on the torque shaft. The whole flap system is driven by a single electric motor; there is an emergency handle in the fuselage.

Flight Deck

The aircraft is intended for operation by a crew of two pilots, but there is space for a radio operator's station if this is required by operators. Each pilot has a full blind-flying panel. Engine and fuel controls and trimmers are on a console between the pilots. All the main engine instruments are mounted between the blind-flying panels. Above there is an emergency panel with all the appropriate indicators and switches.

On the first pilot's side console is the nosewheel steering control, interphone and jackboxes, oxygen selector and Sperry Gyrosyn compass control. The second pilot's side console carries the pressurization controls and oxygen and interphone



connections. Below the side consoles are stowages for documents, oxygen masks, etc.

The radio controls are mounted centrally on a roof panel. On either side are panels carrying controls for the electrical systems, engine starting, de-icing and lighting. Behind and above the pilots are the electrical distribution panels carrying circuit breakers and fuses; below these panels the radio and radar equipment is arranged in air-cooled crates.

Technical Details

Dimensions and accommodation of the Series 1 and Series 2 Avro 748 are the same; they are given below. Their powerplant, weights and performance differ and are tabulated on previous page.

DIMENSIONS.—Span, 95 ft.; overall length, 67 ft.; overall height, 24 ft. 10¼ in.; gross wing area, 795 sq. ft. Internal cabin dimensions: length, 46 ft. 6 in.; max. height, 76 in.; max. width, 96.5 in.; floor area, 296 sq. ft.; usable volume, 1,990 cu. ft.

ACCOMMODATION.—Mixed-class seating, 40 passengers; max. coach-class seating, 44 passengers.

AVRO 748 SUPPLIERS

The following list of suppliers for the Avro 748 feeder-liner has been provided by A. V. Roe and Co., Ltd.:—

Aerocontacts, Ltd.; Aero Controls, Ltd.; Aerogalley, Ltd.; Aircraft Furnishings, Ltd.; Aircraft-Marine Products (Gt. Britain), Ltd.; Airmed, Ltd.; Amphenol (Gt. Britain), Ltd.; Amplivox, Ltd.; George Angus and Co., Ltd.; Associated Electrical Industries (Rugby), Ltd.; Automotive Products Co., Ltd.; Avica Equipment, Ltd.; Avimo, Ltd.; Aviquipo of Britain, Ltd.; Beaufort (Air Sea) Equipment, Ltd.; Belling and Lee, Ltd.; Bell's Asbestos and Engineering, Ltd.; Bendix Radio Div.; Besson and Robinson, Ltd.; The Birmingham Guild, Ltd.; British Electric Resistance Co., Ltd.; British Insulated Callender's Cables, Ltd.; British Messier, Ltd.; The British Refrasil Co., Ltd.; British Tyre and Rubber Co., Ltd.; S. G. Brown, Ltd.; Brunton's (Musselburgh), Ltd.; Budenberg Gauge Co., Ltd.;

Cadmium Nickel Batteries, Ltd.; Cannon Electric (Gt. Britain), Ltd.; Cathodeon, Ltd.; Cementation (Muffelite), Ltd., Chelton (Electrostatics), Ltd.; Collins Radio Co.; Connolly (Curriers), Ltd.; Cossor Radar and Electronics, Ltd.; Damic Controls, Ltd.; S. Davall and Sons, Ltd.; Delaney Gallay, Ltd.; Dowty Rotol, Ltd.; Dowty Nucleonics, Ltd.; Dunlop Rubber Co., Ltd. (Aviation and Dunlopillo Divisions); Elliott Bros. (London), Ltd.;

The English Electric Co., Ltd.; Ericsson Telephones, Ltd.; Fafnir Bearing Co., Ltd.; Films and Equipments, Ltd.; T. F. Firth and Sons, Ltd.; Flight Refuelling, Ltd.; Formica, Ltd.; The General Electric Co., Ltd.; Glacier Metal Co., Ltd.; Sir George Godfrey and Partners, Ltd.; Goodyear Tyre and Rubber Co. (Gt. Britain), Ltd.; Graviner Manufacturing Co., Ltd.; Greenpar Engineering Co., Ltd.; Hall and Hall, Ltd.; Hellerman, Ltd.; W. Henshall and Sons, Ltd.; Hickman, Ltd.; High Pressure Components, Ltd.; Honeywell Controls, Ltd.; Hymatic Engineering Co., Ltd.;

Imperial Chemical Industries, Ltd.; Johnson and Johnson, Ltd.; George Kent, Ltd.; The Walter Kidde Co., Ltd.; King Aircraft Corpn.; K.L.G. Sparking Plugs, Ltd.; Latex Upholstery, Ltd.; Lockheed Precision Products, Ltd.; Lodge Plugs, Ltd.; Marconi's Wireless Telegraph Co., Ltd.; Marston Excelsior, Ltd.; Mechanism, Ltd.; Mellows and Co., Ltd.; The Mollart Engineering Co., Ltd, R. W. Munro, Ltd.; Murphy Radio, Ltd.; Newton Brothers (Derby), Ltd.; Normalair, Ltd.; N.S.F., Ltd.; Page Engineering Co. (Sunbury-on-Thames), Ltd.; Painton and Co., Ltd.; Parmeko, Ltd.; Paton Engineering Products, Ltd.; Philips Electrical, Ltd.; The Phoenix Telephone and Electric Works, Ltd.; The Plessey Co., Ltd.; The Power Flexible Tubing Co., Ltd.; Pye, Ltd.; The Pyrene Co., Ltd.;

Ransome and Marles Bearing Co., Ltd.; Redifon, Ltd., Renold Chains, Ltd.; Resistant Equipment, Ltd.; Rist's Wires and Cables, Ltd.; Rolls-Royce, Ltd.; Rose Brothers (Gainsborough), Ltd.; Rotax, Ltd.; Rubbarite, Ltd.; L. A. Rumbold and Co., Ltd.; Sangamo Weston, Ltd.; Saunders Valve Co., Ltd.; SPE Co., Ltd.; Silent Gliss, Ltd.; Simmonds Aerocessories, Ltd.; Smiths Aircraft Instruments, Ltd.; The Sperry Gyroscope Co., Ltd.; Standard Telephones and Cables, Ltd.; Sterling Metals, Ltd.; Strabor, Ltd.; Tecalemit, Ltd.; Teddington Aircraft Controls, Ltd.; Teleflex Products, Ltd.; Texas Instruments, Ltd.; Thermal Control Co., Ltd.; Thermotank, Ltd.; Thorn Electrical Industries, Ltd.; The Torrington Co., Ltd.; Transradio, Ltd.; Triplex Safety Glass Co., Ltd.; The United Flexible Metallic Tubing Co., Ltd.; Vetrona Fabrics, Ltd.; Vickers-Armstrongs (Aircraft), Ltd.; Vokes, Ltd.; Walker and Schofield, Ltd.; Walters Electrical Manufacturing Co., Ltd.; Wallington, Weston and Co., Ltd.; Ward, Brooke and Co., Ltd.; A. Wells and Co., Ltd.; A. J. Whittemore (Aeradio), Ltd.

Rotol propellers of the Avro 748 are similar to those of the Friendship and Argosy.

Although the Avro 748 propeller has such a large diameter there is a 2-ft. clearance between the propeller tips and the ground, and between the tips and the fuselage side; both these dimensions are greater than those on the Viscount. This requirement for ground clearance helped decide the nacelle position of the Avro 748. Other needs which dictated its location were that the fail-safe structure of the wing should not be jeopardized by the engine installation; that the jet-pipe should pass over the wing; and that the undercarriage should not enter the wing torsion box.

Engine cowlings and mountings are bought by Avro from Vickers. The cowlings are the same as those on Viscount 800 inboard engines.

The engine auxiliary-drive gearbox and major auxiliaries are in a fireproof bay in the upper part of the nacelle behind each engine. Each engine drives a 22-kVA. three-phase alternator, a 6-kW. 28-V. DC generator, a Godfrey cabin blower, a Mk. 9 Lockheed hydraulic pump and a tachometer generator. An engine-synchronizing alternator can also be installed if required.

Fuel System

There is a 570-Imp.-gal. integral fuel tank in each wing outboard of the engine. Fuel is supplied by gravity to a collector tank mounted in the torsion box inboard of each engine; from this, two electrically driven fuel pumps supply the engine. Each pump can supply the maximum engine demand.

A cross feed between the collector tanks is provided so that each fuel tank can supply either or both engines. Two of the four fuel pumps can fail without restricting the flow of fuel to the engines. The capacity of the fuel system could be increased by extending the tanks outboard along the wing or by the introduction of tip or underwing tanks.

Pressure refuelling is standard on the Avro 748, but the aircraft can also be gravity fuelled. There is a Smiths Waymouth fuel-gauge system and in addition, for refuelling, there is an Avro-designed drip-stick system. These indicator sticks can be unscrewed from under the wing and lowered until fuel drips from them, when the volume of fuel in the tank can be read from calibrations on the stick.

The aircraft has two water-methanol tanks which are in the wing trailing-edge fillets. They are bag tanks; each holds approximately 33 Imp. gal. and has an electrically driven pump which normally feeds the engine in its wing. A cross-feed system with cocks manually operated from the crew compartment allows the tanks to supply either engine. Float gauges indicate the amount of water-methanol in each tank.

Fire-protection

A Graviner fire-protection system is installed and each powerplant and nacelle is divided into four zones. The first stretches from the propeller to the rear of the compressor casing; the second from there to the engine firewall; the third is round the jet-pipe shroud and main wheel bay; and the fourth contains the auxiliary drive gearbox and the engine-driven components of the electrical and hydraulic systems. Fire extinguishant is provided for the first, second and fourth of these zones.

There is a Firewire indicator system and two 12-lb. bottles of methyl bromide extinguishant, one in each nacelle, with a cross-feed giving two-shot protection. The indicator system gives independent warning of nacelle fires and of engine overheating.

In the past, engine overheating has on occasion led to fruitless use of the extinguisher system following which, the engine fire has broken into the nacelle after the methyl bromide has been discharged. With the system on the Avro 748 an indicator in the engine oil-breather pipe gives a warning if the engine overheats; it can then be shut down without discharging the methyl bromide; which is in reserve to deal with a nacelle fire.

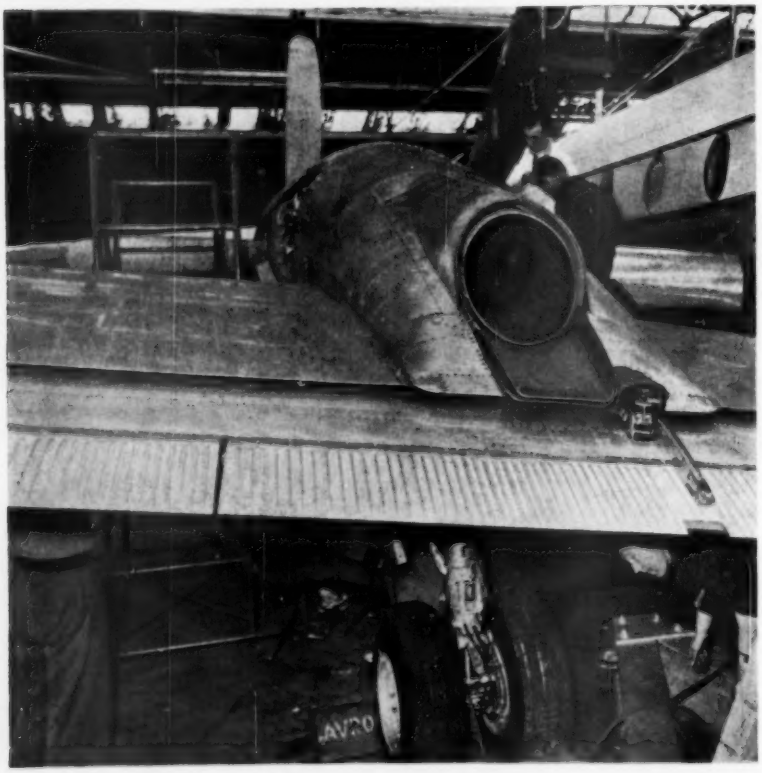
A second engine-overheat warning will also be installed in future to give a warning if cooling air from the turbine bearing is overheated. Thus there will be three warning systems, two of which will require the engine to be shut down without the discharge of the methyl bromide; this will be available if a nacelle fire follows.

Hydraulics

Lockheed components are used almost exclusively in the hydraulic system; most are of the type installed on the Viscount. The hydraulic fluid used is DTD585; Avro has considered the use of fire-resistant fluids, but they would only be used if specifically requested.

Undercarriage retraction, braking and nosewheel steering are hydraulic. In addition, Avro 748 operators may have an hydraulic propeller-brake to special order. The two engine-driven hydraulic pumps are supplied with fluid from a reservoir in the starboard undercarriage bay. They deliver fluid at 2,500 p.s.i. to the services and to the main hydraulic accumulator. Stainless-steel hydraulic lines are used on the H.P. side and for pipes passing through fire zones.

The brakes on the inner and outer of the paired main under-



JET-PIPE.—Engine jet-pipes of the Avro 748 pass over the wing. In this view can be seen the trailing-edge tab flap which is lowered to a greater angle than the flap itself to increase drag during the landing approach.

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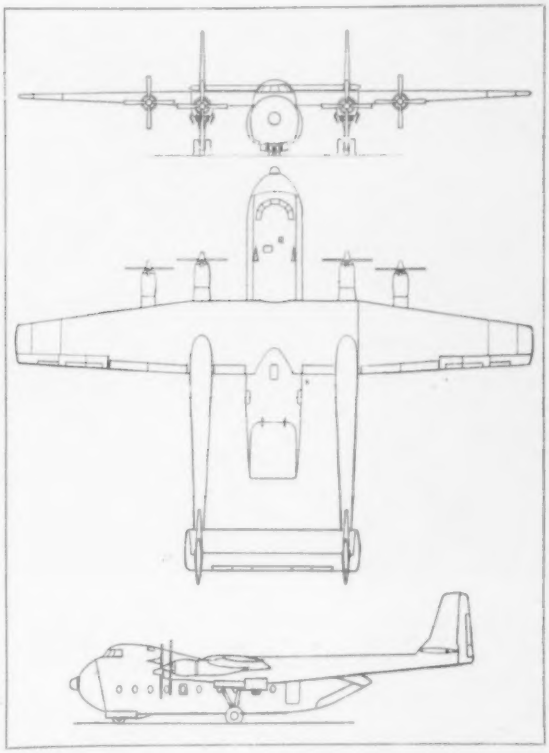
Progress with the Military Argosy



A PROTOTYPE of the Armstrong Whitworth Argosy 660 military transport for the Royal Air Force is expected to make its first flight later this month. A statement by the company giving this news also discloses that a second order for these aircraft had been received from the Ministry of Aviation bringing the total now on order for the R.A.F. up to 40. This increase was, in fact, forecast by the Under-Secretary of State for Air in March when he stated in the House that the first Argosy 660s would be in service with the R.A.F. in 1962.

Although the first production aircraft for Transport Command is not scheduled to fly until December, the pre-production prototype now nearing completion at Baginton will permit flight assessment of the 660's ingenious "beaver tail" rear loading door to be made well in advance. This door has been specially designed to allow the air-dropping of heavy equipment. On the ground, when it is opened, the bottom half is lowered and extended to form a loading ramp. The full-width front door that is available in civil Argosies will not be incorporated in the R.A.F.'s aircraft—although it can be provided in the military version should it be required.

Powered by four Rolls-Royce Dart turboprops, the Argosy 660 has a high rate of climb which is advantageous in reducing the time taken to regain cruising altitude and resume pressurization after dropping a military load. Based on the civil Argosy the 660 has been designed "to combine maximum rôle versatility with maximum operational reliability and economy." Although it is essentially a tactical transport the use of in-flight refuelling gives the aircraft a useful potential as a long-range transport.

Its operational versatility is such that in addition to its basic duties as a freight carrier, it can also be used as a V.I.P. or troop transport, for casualty evacuation, as a mobile battle headquarters, or for paratroop dropping. For this last-named rôle special doors are provided on each side of the rear fuselage to permit simultaneous dropping from both sides of the aircraft.

In its transport rôle the Argosy 660 has been said to be capable of accommodating "many of the missiles in current use." It can carry 14 tons of bulky equipment including guns, trucks and half-track vehicles.

First released photograph of the fuselage of Armstrong Whitworth's Argosy 660 military transport prototype on the final assembly line in the Coventry factory.

Diverse Activities at Fokker

By J. R. Cownie

A CONTINENTAL manufacturer with a long association with aeronautical development, the Fokker company of Amsterdam has at the present time an expanding programme of aircraft and missile production. Recently we were given the opportunity to see for ourselves some of these diverse activities in progress and we found it a refreshing experience.

As well as producing its own Friendship transports, the company is designing and building the wing centre-section and nacelles of the Breguet Atlantic maritime-reconnaissance aircraft; preparing for the final assembly of Lockheed Starfighters for Germany and Holland; and will also build launchers for the Hawk surface-to-air missile.

It will be recalled that the Republic Aviation Corporation recently bought an interest in the Fokker company; as a result, the latter will be concerned in supporting the operation of the latest Republic aircraft in Europe, the F-105 Thunderchief; it already overhauls F84-Fs and Es. The company will also benefit from a Republic VTOL research programme; and—according to a Press release issued last March when Republic's association with the company was announced—this will allow Fokker "to make available in a short time period a vertical take-off aircraft especially designed for NATO needs."

This list of Fokker's future activities shows how much the company will benefit (a) from the growing co-operation between the aircraft industries of France, Germany, Holland, Belgium and Italy, and (b) from the practice of partnership agreements between European companies and those overseas.

Typical are the licence agreements for producing in Europe U.S. aircraft, missiles and engines, such as the Starfighter, the Hawk SAM and the J79 turbojet, and the purchase of an interest in European companies. Examples are the Pratt & Whitney interest in the French engine company SNECMA; the United Aircraft Corporation stake in the German Weser company and Lockheed's interest in the Italian Macchi company.

Much has been said in favour of collaborative production and development of military aircraft for Europe. It is argued that no one country can today afford to develop an aircraft purely for its own use, particularly as the production run will inevitably be too low for an economic unit cost. With collaborative development the design effort of the various countries need not be duplicated and the overall European demand will be large enough to ensure a worthwhile production run.

The Lockheed F-104G will be produced on these lines for

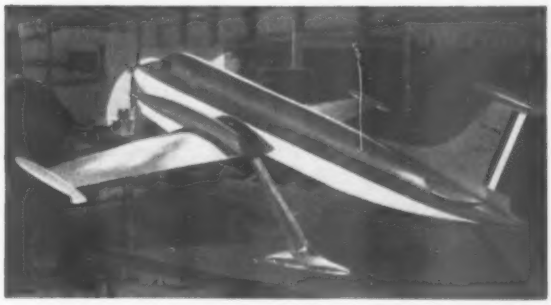
Among current work done by Fokker is the overhaul of NATO Republic F84-F Thunderstreaks. At the top of the page is a general view of Fokker's Schiphol factory.

In the period 1961-64, much of the company's production capacity will be devoted to the Lockheed Starfighter programme; this F104-F, in Luftwaffe markings, is an American-built one.

the air forces of Germany, Holland, Belgium and, possibly, Italy. The Breguet Atlantic maritime-reconnaissance aircraft is being developed jointly by France, Germany, Holland and Belgium; it will have a British engine—the Rolls-Royce Tyne—probably built under licence in France by Hispano Suiza. Another European project is the Transall C-160 military transport, which is being developed jointly by France and Germany; it is also to be Tyne-powered.

The official title of the Fokker company is Royal Netherlands Aircraft Factories Fokker. But, despite this title and the fact that Prince Bernhard is one of the company's directors, it is not State-owned. It was originally formed as a private company, wholly owned by the Fokker family, but in 1937 its shares were put on the open market, with the Fokkers retaining a controlling interest. During the War they were forced to sell their shares to Germans, with the result that at the end of the War the company was taken over by the Dutch custodian of enemy property.

Shares were then sold to two major shareholders, a bank and a shipbuilding company, the balance of more than 50% being sold on the stock market. Until recently the issued



A model of the Breguet Atlantic for which Fokker is to design and build the centre wing and engine nacelles.

capital of the company was 2,625 shares, each with a nominal value of 1,000 guilders (approximately £100). When Republic bought an interest in the company, 1,000 new shares were issued to it at a price of 3,105 guilders apiece, increasing the total capital to 3,625 shares. Thus Republic now holds a 27.5% interest in the company, which cost it approximately £310,000.

Incidentally, Fokker shares are highly regarded in Holland; their market value now is about 430% of the nominal value, compared with about 85% 12 years ago. This also suggests that the Republic interest in Fokker was bought at a bargain rate.

Fokker has three factories—the main one is at Schiphol, where the aircraft are assembled; the others are at Ypenburg and Dordrecht. Although Schiphol, outside Amsterdam, is a large and very busy international airport, it is used by Fokker for test flying of both the civil and military aircraft. This arrangement might be expected to cause confusion, but it apparently works well. It is rather as though the Hawker factory were based at London Airport and Hunters test-flown from there—Dutch-built Hunters, in fact, *were* test-flown from Schiphol.

At present the company employs 4,200 people compared with 4,800 at the beginning of 1959, but the labour force is now being increased to meet the new production programmes. Total floor area of the three factories is 1,173,000 sq. ft.; it is hoped that future production can be handled without expanding these facilities, but plans are available for a new assembly hall at Schiphol if its construction proves inevitable.

The major product of Fokker at present is its F-27 Friendship transport, which is also built under licence in the United States by Fairchild. Firm orders for the Fokker-built F-27 now total 81, and 83 have also been ordered from the Fairchild production line.

Nearly 40 Fokker-built aircraft have been delivered and, with current production running at between three and four aircraft a month, present orders will not be completed before mid-1961. Troopships—military F-27s—for the Royal Netherlands Air Force are on the production line now and aircraft for Turkish Air Lines have just been completed.

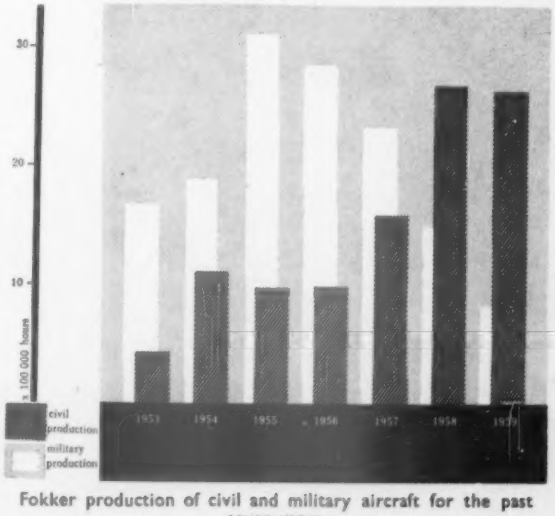
By the end of June the Friendships in service had completed 175,000 flying hours. In airline service the utilization of the aircraft is about 5½-6 hours a day.

With its current facilities Fokker could build six Friendships monthly, but production is being kept at a lower rate because demand does not justify a higher output. Comparatively early delivery can be offered to customers with production running at the current rate.

During 1959, sales of the aircraft were slower than expected, but improved towards the end of the year with an order from the Indian Airlines Corporation, repeat orders from Braathens and Ansett-ANA and a doubling of the aircraft ordered for New Zealand National Airways Corporation. By the beginning of May, 1960, 36 Friendships had been delivered out of the total of 77 on order for 24 customers in 12 different countries. Since then four more aircraft have been ordered.

Approximately 100 Friendships must be sold before Fokker reaches the break-even point, neglecting the effect of licence payments by Fairchild; if these are taken into account, the break-even number is lower. A loan of 25 million guilders for development of the aircraft was made by the Netherlands Institute for Aircraft Development, through which State contributions are available for aircraft development. This loan is being repaid by a levy on each aircraft sold. Other money for Friendship development was raised by bank loans and from Fokker reserves.

Friendships powered by both Rolls-Royce Dart RDa.6 and RDa.7 turboprops are being built and the one type does not



Fokker production of civil and military aircraft for the past seven years.

appear to be driving out the other. In general, the aircraft with the RDa.7 is preferable for operation in the tropics or on routes with high-altitude airfields.

Executive, military and combined passenger/freight versions of the Friendship have been produced as well as the standard transport. A future development, to be known as the F-27S, is expected to have a short-field performance competitive with that of the D.H.C. Caribou. Both civil and military versions of this type are planned, although the initial interest is expected to be mainly military.

This projected aircraft differs from the civil type in having double-slotted flaps, a variable-incidence tailplane and installation of the Dart RDa.8, an up-rated military version of the RDa.7. The prototype Friendship is being modified to this standard and is expected to make its first flight in this form next September. No new design is needed for the double-slotted flap, as a unit of this type was originally built for the prototype, although a single-slotted flap is installed on production Friendships.

The Rolls-Royce RDa.8, which is to be installed in the F-27S, delivers 2,470 s.h.p. for take-off and has a maximum continuous power of 2,210 s.h.p. The aircraft will have an all-up weight of 37,500 lb., which could be increased later to 40,000 lb. Its calculated take-off distance to 50 ft. is 1,250 ft. in I.S.A. conditions and 1,500 ft. at I.S.A. + 30° C. Its landing distance from 50 ft. is 1,300 ft. in I.S.A. conditions.

Later developments of the Friendship are expected to utilize the higher-powered Dart RDa.10. Fairchild are interested in producing an RDa.10 version with a fuselage stretched by 7 ft.; this would allow 48 passengers to be carried, as well as giving more freight space. Eastern Air Lines is said to be interested in this aircraft.

Military Work

From 1954 onwards building of Hawker Hunters under licence formed an important part of Fokker activities. This production, however, has now come to an end.

Between 1961 and 1964 much of the company's productive capacity will be devoted to the Lockheed F-104G Starfighter. Fokker will work with the Dutch company Aviolanda and the German Northern group of Focke-Wulf, Hamburger and Weser. Because of Dutch security regulation little information can be given about the Fokker F-104 programme, but the company states that it will be responsible for final assembly and flight testing of all the Starfighters to be built by the Northern group. Lockheed said in April that there were firm orders for 375 aircraft to be produced by this group and Belgian companies; additional orders were anticipated.

Fokker is also playing a major rôle in the development of Breguet Atlantic maritime-patrol aircraft, for which it is designing and building the centre wing and engine nacelles. Two prototypes are being built. Dornier is responsible for the rear fuselage and tail unit and Sud Aviation for the outer wings. Breguet is building the fuselage and will be responsible for final assembly and test flying, which will begin next year. The Belgian A.B.A.P. group of companies is also involved.

The project is being financed by the French, German, Belgian and Dutch governments, and the United States through the Mutual Weapons Development Programme. Rolls-Royce are supplying the Tyne turboprops to power the prototypes and much of their electronic equipment will come from the U.S. Complicated organizational and technical problems are involved in an international programme of this type, but according to Fokker they have been solved satisfactorily.

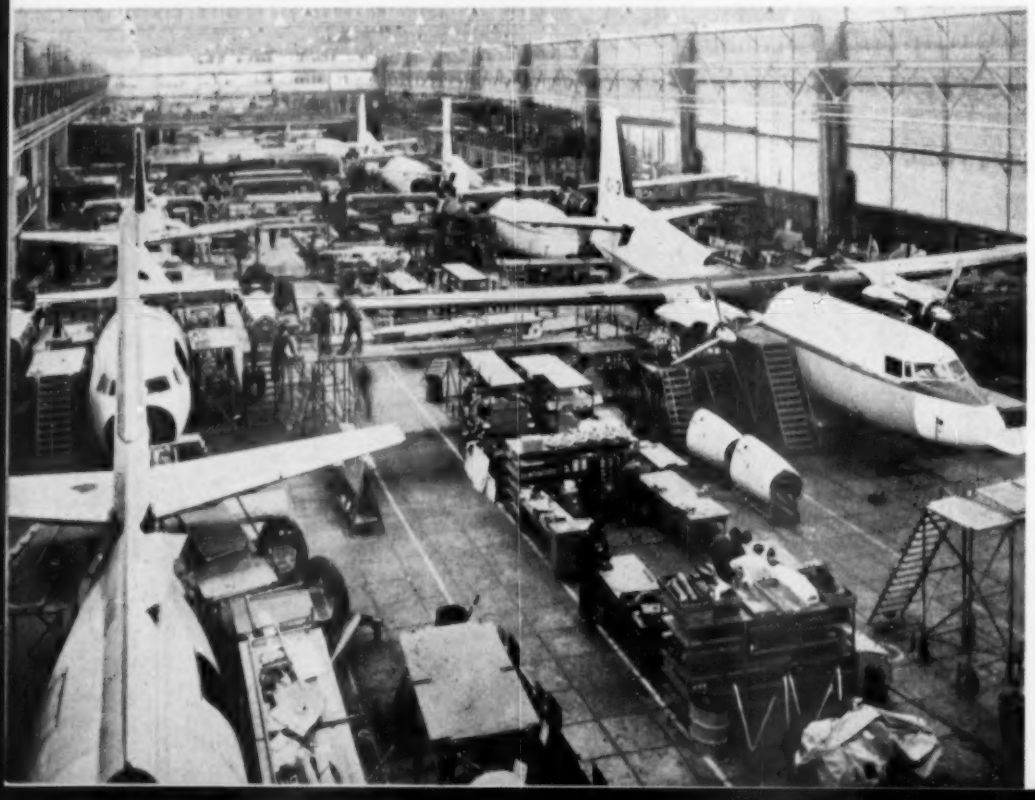
In designing the inner wing the company has relied on the bonding techniques with which it has considerable experience. The wing is built up of sandwich panels with aluminium-alloy honeycomb cores which are Redux-bonded to the faceplates. If, as expected, the Atlantic goes into large-scale production, a considerable part of the Fokker factories will be fully occupied for several years.

As part of the European group which will build the Hawk surface-to-air missile under licence, Fokker will be responsible for producing launchers. The company is working with Philips on this and with the Belgian A.S.E.C. and F.N. companies. Fokker has expressed its confidence that all these contracts will lead to permanent ties in the coming years and add to the consolidation of its business.

Other military business will probably come from the new link with Republic. Republic F-104D Thunderchiefs will be operated in quantity by the U.S.A.F. in Europe, and Fokker will probably play a part in the associated overhaul, repair and modification programmes needed to support these aircraft. Fokker will also probably produce spares for NATO F-84s if permission is given for tooling owned by the U.S. Government to be transferred to Holland. The link with Republic will not affect in any way Fokker's responsibility for the Friendship and for the Starfighter, Atlantic and Hawk programmes. But the results of Republic research programmes will be available and these are expected to prove very useful, particularly in the VTOL field.

Although well placed for production of aircraft and missiles for several years, the company is keen to diversify its interests. Most of its non-aeronautical work has been on a fairly small scale; examples of its industrial products are plastics yachts, caravans, radar aerials and sheet-metal shapers. It also sells equipment which was developed originally for use in its own factories; examples are the Fokker hot-joggle machine and a bond tester. This has been developed for non-destructive testing of both metal-to-metal and skin-to-sandwich core bonds; it indicates the quality of a bond and gives its shear strength to within ± 570 lb./sq. in.

No visitor to Fokker at Schiphol can fail to be impressed by the neatness and tidiness of its factory and the apparent efficiency of its organization. It is a company facing a prosperous future, largely as a result of its collaboration in international, rather than national, programmes of aircraft development and production.



A batch of military F-27s for the Royal Netherlands Air Force is now on the final-assembly line at Schiphol.

SURVIVAL DEPENDS ON VERSATILITY

IN DEFENCE AGAINST AIR ATTACK AS IN NATURE

It is not only in Natural History that versatility—the ability to perform more than to function—is of critical importance. It is equally important in the field of defence against air attack—and here a vital weapon is the guided missile.

Missile systems can either be operationally static—permanently sited on fixed concrete emplacements—or, like the English Electric Thunderbird, they can be operationally mobile—able to be taken across country in standard military vehicles and redeployed in a few hours.

The important thing is that the mobile missile—Thunderbird—can also operate in a static role; it can stay put on a chosen site for as long as that site continues to be the most suitable one.

But if the unexpected happens—and in war it always does—Thunderbird, unlike a static system, can be away and in action again to meet a new threat overnight. It is operationally flexible.

Thunderbird is now in service with the Army. Its inherent mobility allows for quick changes of plan, easy re-siting of defence and provides the versatility which is of ever increasing importance to present and future air attacks.

EVOLUTION CONTINUES

An even more advanced version of Thunderbird is now completing its development. It will give longer range and better performance against low level attack whilst retaining its former mobility and air transportability.

Evolution is going on—to give still more versatility to the Thunderbird weapon system upon which survival against air attack may depend.

'ENGLISH ELECTRIC' THUNDERBIRD

ENGLISH ELECTRIC AVIATION LIMITED · *GUIDED WEAPONS DIVISION* · LUTON · STEVENAGE · WOOMERA

MEMBER COMPANY OF BRITISH AIRCRAFT CORPORATION

GW23

The *Short* SEACAT
–choice of four navies

The Royal Navy, the Royal Australian Navy and the Royal New Zealand Navy are all fitting the Seacat—Shorts new ship-to-air guided missile—as their standard close-range anti-aircraft weapon.

The Royal Swedish Navy has also chosen the Seacat after a careful study of all internationally available weapons of this class.

Developed by Shorts under British Ministry of Aviation contract, the Seacat, capable of exceptional accuracy and manoeuvrability, is rapidly being acknowledged as the most effective close-range defence weapon of today.

AT **Shorts**
IDEAS TAKE SHAPE
on time

SHORT BROTHERS & HARLAND LTD
QUEENS ISLAND, BELFAST, NORTHERN IRELAND
The first manufacturers of aircraft in the world

Grant for the Spaceflight Academy

A GRANT of $75,000 has been made by the Daniel and Florence Guggenheim Foundation in support of the Academy of Astronautics, set up last year during the London meeting of the International Astronautical Federation. This will cover the first three years of the Academy's operation. It comes from the same source as furnished the original funds for the pioneer researches of Robert H. Goddard, "the father of American rocketry," between the Wars.

Prof. Theodore von Kármán, chairman of the Founding Committee of the Academy of Astronautics, has said that the new association will provide "what may be the only common intellectual meeting ground" for the scientists and engineers of all nations, including those of East and West. Consequently, he believes the Acadamy can bring about the peaceful exploration of space in the shortest possible time, and for the greatest benefit of all. "Now it is up to the representatives of space science and engineering to show true ways of international co-operation in astronautics," he said.

In his statement announcing the grant, Mr. Guggenheim said the Foundation's support of the Academy resulted from its long nistory of interest in aeronautics. In addition to aiding the Goddard researches, the Foundation supports research centres in jet propulsion at Princeton University and the California Institute of Technology, an Aviation Safety Center at Cornell University, an Institute of Flight Structures at Columbia University, a Center of Aviation Health and Safety at Harvard University, and provides a number of fellowships in the flight sciences.

He observed that the purpose of the new Academy would be to bring together in one body the outstanding scientists and engineers of the World to further the more rapid developments of spaceflight and related sciences. "These scientists and engineers," he said, "will be chosen for their ability to contribute to astronautical developments without regard to nationality. Under the leadership of Prof. von Kármán, they are expected to stimulate rapid progress in this very new and increasingly important field.

"For this reason," continued Mr. Guggenheim, "the directors of the Daniel and Florence Guggenheim Foundation have agreed to provide $75,000 for its operation during the first three years. After that the Academy is expected to support itself through funds from other sources, including the income from a proposed international publication on astronautics and contributions from the constituent societies of the I.A.F."

The International Astronautical Federation was founded 10 years ago for the express purpose of encouraging international co-operation in space research and astronautics; some 30 nations are now represented including the U.S.S.R. and the United States. The United Kingdom member, the British Interplanetary Society, has more than 3,500 members and is one of the most influential technical societies in the field of astronautics.

Under present arrangements, the Academy of Astronautics will be established as a going concern at the Stockholm meeting of the International Astronautical Federation in August. It is expected that a permanent headquarters will be established in Paris, where the French Government has offered rent-free accommodation.

Principal powers and functions of the Academy, according to Prof. von Kármán, are:— (1) To advise the president of the I.A.F., when requested; (2) to hold scientific meetings and make scientific studies and reports; (3) to publish an international technical journal devoted to astronautics; (4) to award medals and prizes intended to further progress in the field; and (5) to carry out such tasks as may be deemed desirable for promoting the advancement of astronautics.

Membership of the Academy will be restricted to leading scientists who have worked in astronautics in basic science, engineering, and the life sciences. Initial members include Prof. von Kármán, Prof. M. Nicolet, chairman of the International Council of Scientific Unions Committee for the I.G.Y., Belgium; Prof. A. C. B. Lovell, England; Dr. Eugen Sänger, Germany; Prof. Hermann Oberth, Germany; Prof. J. Ackeret, Switzerland; Prof. Rudolph Pesek, Czechoslovakia; Dr. J. A. Van Allen, U.S.A.; and Prof. A. N. Nesmeyanov, President of the U.S.S.R. Academy of Sciences.

Apart from the I.A.F., there are only two other major international organizations in the field. These are the United Nations Committee on the Peaceful Uses of Outer Space, and the Committee on Space Research (Cospar).

New Pacific Rocket Tests

SOVIET multi-stage rockets of a new type will be test-fired into the central Pacific between July 5 and 31, according to the Tass news agency. Ships and aircraft have been warned to stay clear of a 17,136-sq.-mile area north-east of the Gilbert and Ellice Islands. The rockets will be fired without the final stage. Launchings are being made "in accordance with the programme for further research and experimental designing in the sphere of space problems." Special vessels of the Soviet fleet will record the fall of the "penultimate stages of the carrier rockets."

These proposed tests follow two earlier firings in January when multi-stage rockets were said to have travelled nearly 8,000 miles, one falling within 1.25 miles of a specified target. In this case it was stated that a dummy final stage was fitted.

It was a rocket vehicle of this type that successfully orbited Russia's 10,000-lb. "satellite-spaceship" on May 15. As we remarked at the time, this payload falls between the capability of the Centaur and Saturn boosters, still under development in the United States. The suggestion that the July test-firings will involve a "new carrier rocket" is rather surprising in view of the capabilities of the existing Soviet booster and hints at more spectacular space-projects in store.

Although it is likely that the new multi-stage rocket is primarily related to the Soviet man-in-space programme, it must not be forgotten that the Russians have already forecast attempts to send instrumented payloads to the nearer planets. They are also preparing new probing missions to the Moon.

MISSILE AIR-TO-AIR.—This remarkable picture of a ballistic nose-cone re-entering the atmosphere was taken by a cameraman in a U.S.A.F. C-54 tracking aircraft operating from Ascension Island. The nose-cone, designed by the Avco company, was launched by a two-stage Titan ICBM less than 30 minutes before and has travelled 5,000 miles. Photographic technique was as follows: a 35-mm. camera was used with open shutter to record trajectory of re-entering vehicle. To illuminate the aircraft interior, a flash-gun was operated after the re-entry. Equipment at left of picture is being used by Avco personnel to track re-entry body visually and acquire radio signals from a transmitter in the nose-cone.

A Self-navigating Space-probe

IN the solar probe Pioneer V, one has an example of a space-vehicle of miniature proportions which can transmit to Earth, over millions of miles, information of conditions which exist in another part of the Solar System. Launched on a path which takes it around the Sun between the orbits of Earth and Venus, it has already secured important data on the emissions of solar flares and has also revealed something of the magnetic fields which permeate space.

With this vehicle, however, no attempt has been made to aim, or steer, it close to another planet. The latter must now be regarded as a prime objective for the next generation of exploratory space-probes.

Photographing Mars

To investigate the problems involved in an interplanetary venture of this kind, the Massachusetts Institute of Technology has produced a feasibility study of a probe designed to intercept Mars in its orbit and to secure a photograph from fairly close range. A further requirement was to provide a guidance system of sufficient accuracy to ensure that the photograph was returned to Earth after the mission.

In the design study, which occupied the Instrumentation Laboratory of M.I.T. for two years, many of the latest techniques in navigation, control, communication, gas-jet steering, and re-entry, have been brought together in one ingeniously contrived vehicle. The various features are shown in the accompanying drawings. Equipment includes a miniaturized digital computer, electro-mechanical/optical apparatus for navigation and attitude control, a micro-thrust rocket for providing velocity corrections, a long-range communications transmitter for telemetry, a radar transponder for impact prediction on the return to Earth, and a re-entry vehicle containing the camera and recovery aids. All this has been provided for a total mass of only 340 lb., and the actual vehicle would have the proportions of a table-model television set.

In an 810-page, four-volume, technical document recently cleared for publication by the U.S.A.F. Ballistic Missile Division, A.R.D.C., the hypothetical flight-plan is set out in detail. Launching would occur on Jne. 17, 1962, and the mission would last 3.2 years.

Calculation indicates that the probe would be ejected from the launching rocket at a velocity of 38,200 ft./sec. to enter an eccentric orbit around the Sun with an apogee beyond the orbit of Mars. After separating from the final stage, the probe would be allowed to proceed unstabilized for about 10 minutes. The micro-thrust rocket embodied in the probe would then be fired to correct any tumbling motion and permit the operation of navigational equipment.

After a further delay of several minutes, wide-angle Sun-seekers would be brought into play to act on the internal fly-wheels to position the probe with its energy collector face towards the Sun. This face of the vehicle embodies solar cells for electrical power supply and a system of thermal control shutters for the purpose of maintaining a reasonable temperature within the probe.

First navigational fix would be made after the first eight hours of the outward journey using the space sextant. This initial fix is all important at the start of the probe's long journey, for upon its accuracy would depend the degree of error to be corrected by power manœuvres months later.

To facilitate tracking and to check the probe's correct functioning, radio messages lasting 20 sec. would be transmitted to Earth at weekly intervals. Each week, also, solar vanes will automatically extend from the side of the probe for the purpose of eliminating any angular momentum that the vehicle has accumulated. These vanes rely on the pressure of sunlight to apply a torque to the vehicle.

The weekly routine of communication and reduction of angular momentum, M.I.T. suggests, would continue until Jan. 21, 1963, when new navigational checks would be made. Sightings would be taken of two stars, the Sun and the planets, to measure angles which would determine the probe's position. A second velocity correction would then position the vehicle more precisely on its course towards Mars.

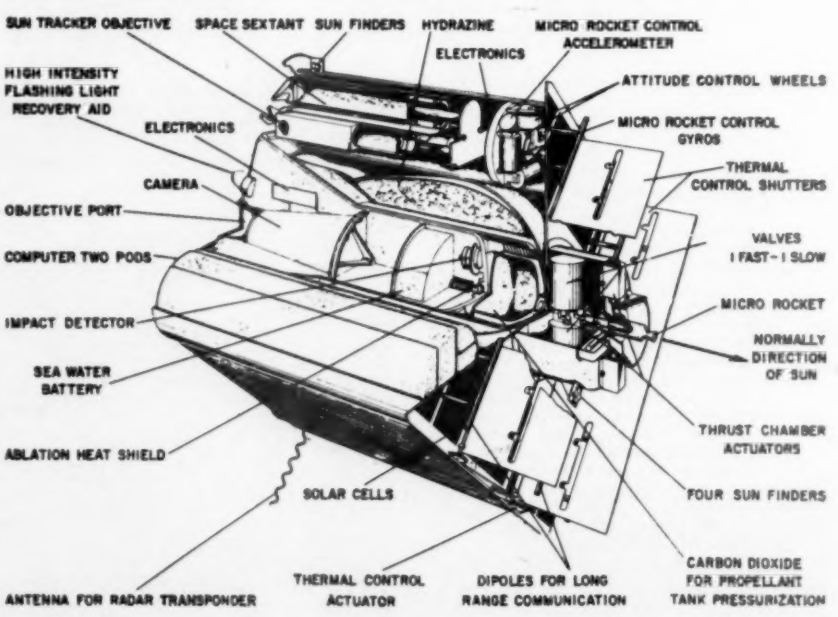
Another correction would be made on Aug. 29, 1963, sighting on Mars and Venus, with a fourth fix scheduled for Jly. 5, 1964. This continual refinement of the trajectory, involving minimum energy-expenditure, should result in a reasonably accurate approach to the destination planet five months after the last correction is made.

Just four days before Mars is reached, a further correction would be made to ensure that the vehicle passes within 200 miles of a pre-selected point in space which is 4,690 miles above the Martian surface. Just before a picture of Mars is taken, the optical system locks-on to the Sun and another star to orientate the probe accurately in the direction of the planet to secure the desired photographic exposure.

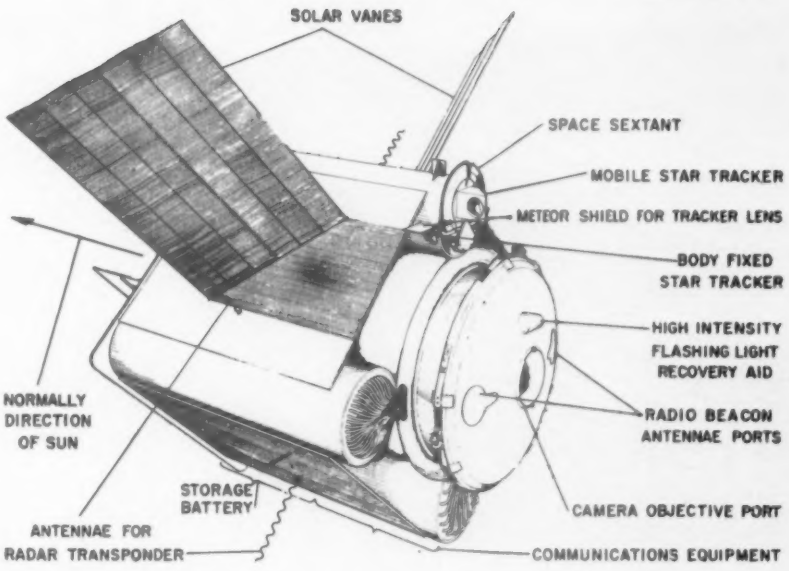
It is believed by M.I.T. technicians that a high resolution photograph obtained in this way would give a clear picture of the topography of Mars. To check the degree of resolution to be expected, Laboratory personnel simulated a photograph of the San Francisco Bay area as it would appear from a height of 5,000 miles. By copying a mosaic of aerial photographs, they produced a composite picture showing an area 140 miles long and 100 miles wide. On this composite photograph could still be seen bridges, farm land, airports and other indications of human habitation.

Returning to Earth

Having secured the picture, the next problem is how to recover it. Leaving the vicinity of Mars, the probe would make another navigational fix three days later. Here it is anticipated that a velocity correction of several hundred feet per second would be required to obtain a correct orbit for the return flight. Another correction would be made on Jne. 25, 1965, and the vehicle then assumed to maintain its homeward orbit for slightly more than two months.



Internal equipment of the 340-lb. self-navigating interplanetary probe designed by M.I.T. A weight breakdown of the various components is given in the table.



External view of the M.I.T. probe showing the solar vanes, optical tracking equipment, camera port, etc.

Astronautics drawings

At sunrise on Sept. 6, 1965, the probe would be roughly 100,000 miles from Earth, scheduled to impact in six hours. Its position should be accurate to within several hundred miles.

When this stage is reached, a radar transponder in the probe would start transmitting a signal and ground-based radar stations would start searching the prescribed area of sky and try to pick it up. As soon as the signal is detected, the radars would begin tracking the vehicle with the aim of narrowing the anticipated area of impact, within a few hours, from a 400-mile to a 100-mile diameter circle. Eventually, an impact prediction of several miles would be obtained.

Just 30 min. before the probe is due to arrive a coded signal would be sent to the vehicle giving the predicted time of impact with the atmosphere. Before this stage is reached, the probe's orientation system would again be brought into play in conjunction with the star-tracking device. This permits ejection from the probe, at the right angle, of a small re-entry vehicle which contains the camera and recovery devices.

	lb.
Structure and propellent tank	65
Digital computer (two pods)	30
Mechanical control components	
Space sextant	13
Attitude-control components	7
Electrical components	
Control electronics	20
Communications	6
Batteries	24
Micro-thrust rocket	
Monopropellent (hydrazine)	100
CO_2 pressurization	6
Thrust chamber assembly	10
Re-entry vehicle	
Camera	10
Instrumentation, recovery aids	11
Structure and heat shield	26
Miscellaneous	10
TOTAL	338

This projectile-like re-entry body enters the atmosphere, is decelerated, and lands in the sea. Its final recovery would be facilitated by a radio beacon and a flashing light.

At least, that is the theory. It is quite obvious that a good deal of preliminary experiment will be required before a mission of this complexity can be brought to fruition and, of course, reliability of the electronic and associated equipment would have to be of a very high order. Nevertheless, in introducing us to the problems of automatic space navigation, it has shown the extent to which robot devices may be put in the future.

There is no intention of developing the vehicle which is the subject of M.I.T.'s exhaustive report. But there can be little doubt that, as a design exercise, it will play a large part in shaping the steerable space-probes of the future.

In conclusion, it may be noted that two major missile companies assisted M.I.T. with its deliberations, Avco Corporation, which did work on re-entry, and Thiokol's Reaction Motors Division, which schemed the small monopropellent rocket motor for making navigational corrections. M.I.T.'s Lincoln Laboratory collaborated on communication aspects.

In addition to the Mars experiment, reconnaissance missions to Venus were also studied.

Earth's Ionized "Corona"

ANALYSIS of data obtained from the Soviet space-probe, Lunik II, before it crashed on the Moon on Sept. 13, last year, has shown that the Earth is enveloped in a "geo-corona" of ionized gas, according to the Soviet scientist Dr. I. Shklovsky. He says this zone extends some 14,000 miles into space.

The 858.4-lb. probe was equipped to measure temperature and pressure inside the vehicle; the magnetic fields of Earth and Moon; heavy nuclei in primary cosmic radiation and other properties of cosmic rays; and meteoric particles in space. The particular instrument involved in the discovery of the geo-corona was a simple ion trap of the type carried in Sputnik III.

Using results obtained from the instrument before the probe hit the Moon, Russian scientists were able to map the way in which ion concentration changes with distance from the Earth. It appears that the geo-corona consists of hydrogen.

The gist of the argument is expressed by Shklovsky as follows: "The lower layers of the Earth's atmosphere always contain water vapour. Higher up, at more than 65 miles, ultra-violet radiation from the Sun breaks up the molecules of water into their component atoms of hydrogen and oxygen.

"Up to altitudes of 100 miles, the Earth's atmosphere is well mixed, and for that reason the relative proportion of hydrogen atoms is more or less constant. But higher still, the atmosphere ceases to mix and the higher we go the more there are of the lighter hydrogen atoms.

"At a height of between 1,000 and 1,250 miles, hydrogen becomes the main element in the Earth's atmosphere. The speeds these hydrogen atoms attain in their thermal motions are fairly large, exceeding escape velocity in most cases. Consequently, the hydrogen atoms in the outermost layers of the atmosphere keep escaping—seeming to vanish into interplanetary space. It is these hydrogen atoms that form the geo-corona.

"If there were no steady replenishment due to evaporation of ocean water, all the hydrogen in the Earth's atmosphere would vanish into interplanetary space somewhat rapidly.

"Calculations have shown that this is why the level of the World ocean has dropped by several metres in the course of the Earth's geological history."

Nike-Zeus versus Atlas

A TEST-PROGRAMME to determine the effectiveness of the Nike-Zeus anti-missile missile in destroying ballistic warheads under realistic attack conditions is to be carried out using Atlas ICBMs as targets. Object of the exercise is to determine how early in its trajectory a ballistic warhead can be identified and intercepted.

It was reported some months ago that the tracking installation would be on Roi Namur Island, some 45 miles from Kwajalein Atoll where the Nike-Zeus launching pads will be located. The Atlas target missiles will be launched from Vandenberg Air Force Base on America's west coast, some 4,800 miles distant. Warheads will be tracked by high-power radars, reported to be of two types—a Raytheon system and a modified version of the RCA radar designed for the BMEWS network.

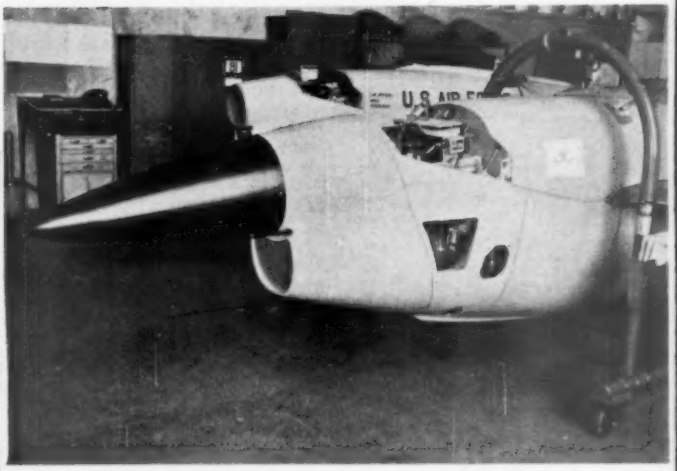
According to the U.S. Defense Department, the tentative plan is for the U.S. Army to purchase 18 Atlas missiles from the U.S.A.F. There is at present no intention to fit Nike-Zeus with nuclear warheads.

Latest Firebee

Production details of the Ryan Q-2C remote-controlled target which was the subject of a special article in our issue of May 13, 1960.

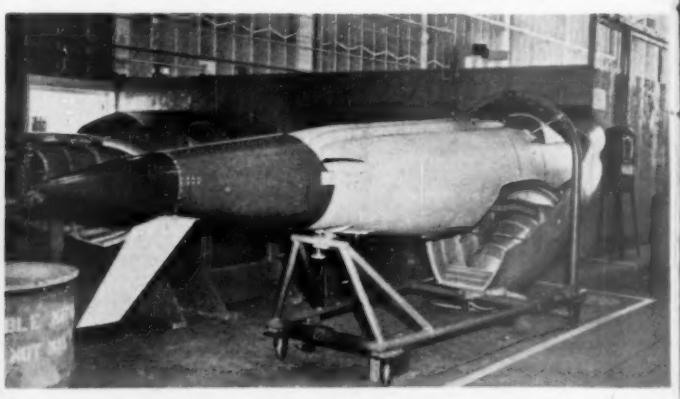
Howard Levy photographs

Above, a Q-2C is prepared for air-launching beneath the wing of a GB-26. Installed in the Firebee is a travelling-wave amplifier which can give the small target plane the "radar echo" of a B-52 bomber.

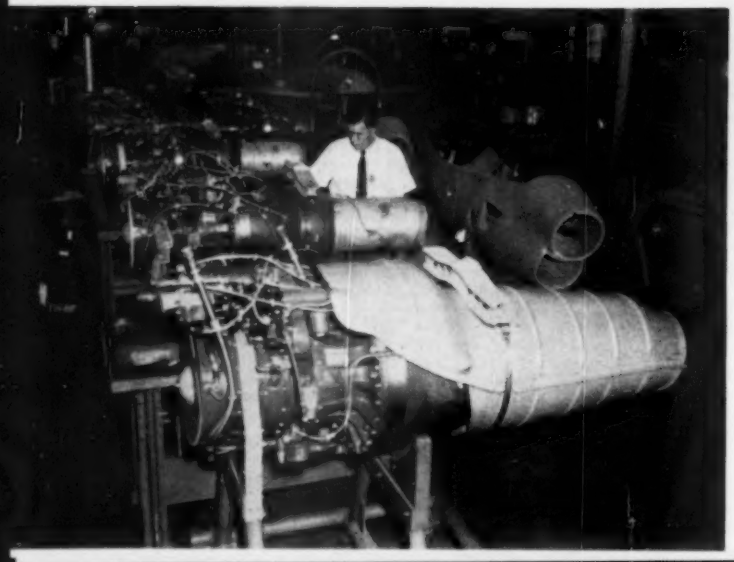


Above, forward section of the Q-2C includes the radome, air-intake, and J-69-T-29 turbojet complete with engine-driven accessories and tail pipe.

Above, the clean lines of the latest Firebee variant are amply demonstrated in this picture of the target plane aboard the Douglas GB-26 parent aircraft.

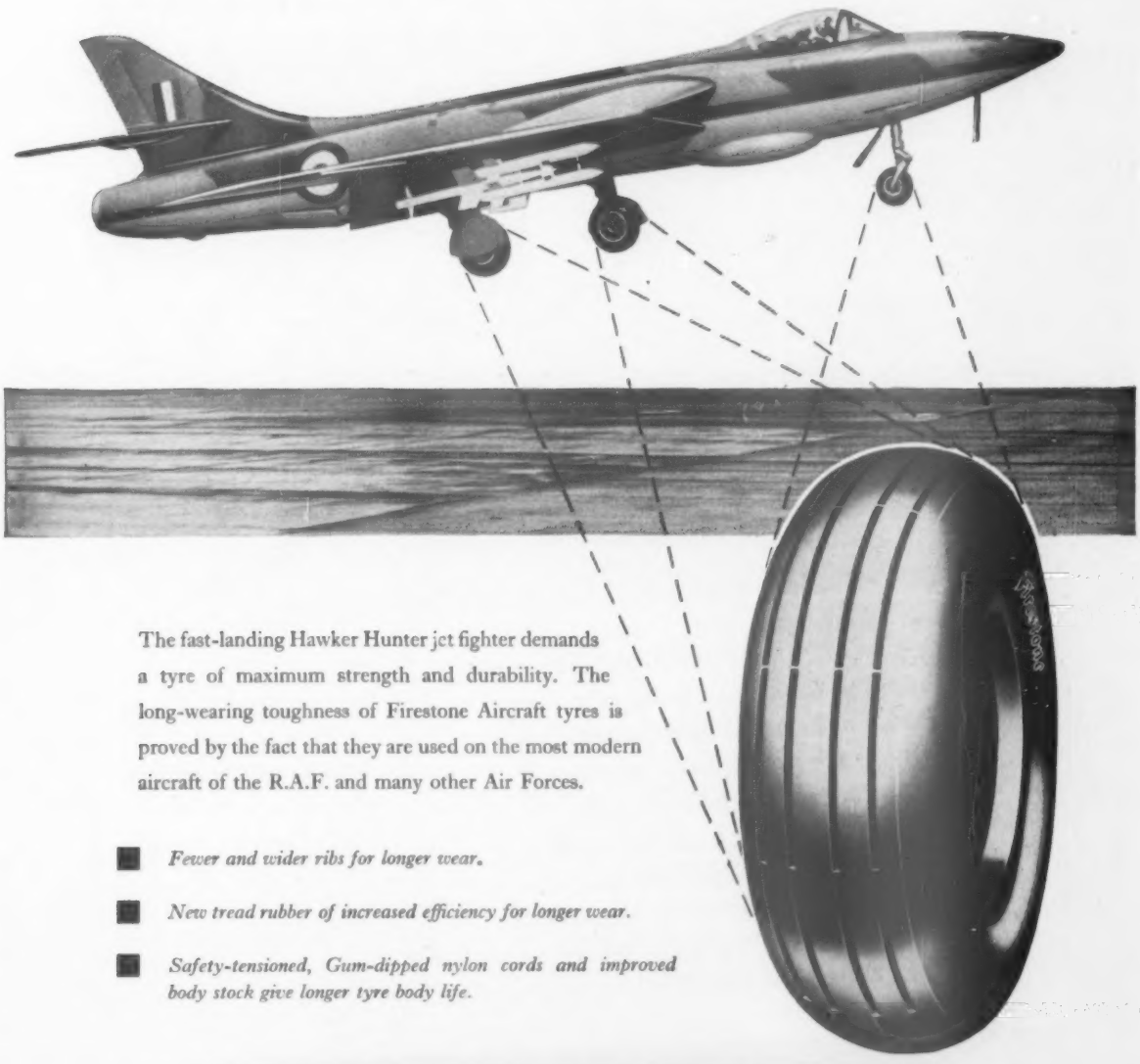


Above, design features of the Ryan Q-2C include an engine nacelle which drops down to permit maintenance and rapid engine replacement. A small vertical stabilizer is mounted under the tail cone.



Left, a line-up of Continental J-69-T-29 engines (rated thrust, 1,700 lb.) being prepared for installation in the latest version of Firebee. Note Q-2C nacelles beyond.

Here's proof of Firestone *Long-wearing toughness!*



The fast-landing Hawker Hunter jet fighter demands a tyre of maximum strength and durability. The long-wearing toughness of Firestone Aircraft tyres is proved by the fact that they are used on the most modern aircraft of the R.A.F. and many other Air Forces.

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- *New tread rubber of increased efficiency for longer wear.*
- *Safety-tensioned, Gum-dipped nylon cords and improved body stock give longer tyre body life.*

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Personal Flying

A RECENT week's news round-up from the personal flying airfields included a note from **Biggin Hill,** where the Surrey and Kent Flying Club report a record day for the year, on Saturday, May 14, when the club aircraft flew a total of 45 hours. Several reductions have been made in flying rates, which currently apply at £4 an hour, dual or solo, for the Tiger and Hornet Moths, 4 guineas an hour for the Leopard Moth, £5 10s. dual and £5 an hour solo for the Chipmunk, and £7 dual and £6 10s. solo for the six-seat Prentice.

Contract rates, with discount of up to 12½%, are available for P.P.L. holders. The club Prentices have become very popular for touring, with a maximum safe range of seven hours at over 100 knots, and are equipped with duplicated VHF for optimum reliability. Another Tiger Moth has been acquired, bringing the club total to six.

● At **Cambridge,** Marshall's Airport have announced that "on call" Customs facilities have been extended to private owners and club aircraft, given 24 hours' prior notification. Air Traffic Control (Cambridge 56293 ext. 8) can make the necessary arrangements. The airfield is open from 09.00 to 18.00 hrs. daily, and these times are variable on request. Standard private and commercial landing fees are charged, but no extra charge is made for attendance of the Customs officer.

The facility is on a trial basis until Sept. 30, 1960, and will be withdrawn by the Commissioners of Customs and Excise if sufficient traffic is not forthcoming.

● From **Kidlington,** the Oxford Aeroplane Club reports that its Tri-Pacer completed over 70 hours on instruction and charter in its first three weeks or so of operation. The first two *ab initio* students to solo on the Tri-Pacer were Victor Bedding and Tony Savile, and many other members have qualified on it. Another recent acquisition was the three-seat Miles Monarch, which is intended almost entirely for touring, being fast, comfortable and economical. It is proving very popular for rallies, and is the subject of much advanced booking.

ONE FOR NORWAY.—As recorded in our previous issue, this Auster D.6—the first production model—was recently delivered in Norway. It is the version with 160 h.p. Lycoming engine; the more powerful D.6/180 is to fly later this month.

● At **Squires Gate,** Blackpool, D. W. Vernon and C. L. Jessop are endeavouring to form a group to buy and operate a Tipsy Nipper. The first cost of this in the U.K. is about £1,130, and the organizers estimate that to finance the project, at least £600 is required. Now that the Kemsley Flying Trust no longer exists, this presents something of a problem, but the organizers propose two classes of membership, for full and associate members, with a different scale of charges and subscriptions, plus a returnable deposit for the former class.

The Nipper would then be operated at either £2 or £3 an hour, according to membership, to cover repayments and all operating expenses, and possibly make a profit on a 300-hr. annual utilization. Prospective P.P.L. or student pilot members can contact the organizers at 23 Northwood Avenue, Southport, Lancs.

Gliding Notes

by Dr. A. E. Slater

NATIONAL GLIDING WEEK at Perranporth clashed with Practice Week at the World Championships in Germany, but it was described last week at the Kronfeld Club where Lionel Alexander emphasized the lighthearted atmosphere of the meeting and the excellent task-setting of the chief instructor, George Collins, who had never set tasks before in his life.

On the first morning he sent all 11 competitors by road to Davidstow Moor, 32 miles to the N.E., where two Tiger Moths awaited them on a disused runway. This was to avoid the sea breeze which is liable to attack Perranporth from both sides of Cornwall, and it did actually prevent anyone completing the dog-leg task around Launceston Castle and back to Perranporth, though Philip Wills nearly did so in his Skylark 3F.

Wills was the only one to complete a triangle next day via Davidstow and Lostwithiel. According to Alexander, there were no thermals below 1,800 ft. and they were limited above by an inversion at 2,300 ft.

On the third day, with a contest for free distance, Philip Wills looked down from over Davidstow to see his most dangerous competitor, Peter Scott, soaring low over a small hillock and apparently about to land. So Wills didn't bother to go farther than 84 miles to Exeter. But Scott recovered and made 211 miles to Godalming in his Olympia 419, taking 8½ hours, including a final hour's soaring in a sea breeze blowing up the Hog's Back, 30 miles inland; while Charles Green of the Midland Club, who was in good form throughout the meeting, went 144 miles to Shaftesbury.

It was necessary on the fourth day to start from beyond Dartmoor for good thermals, and everyone raced with trailers to Roborough, near Plymouth, to get a launch before the sea breeze beat them to it. Not all succeeded, but Wills reached his goal at Weston-on-the-Green, the Oxford Club's site, 163 miles, while Peter Scott made 160 to Watlington, trying to reach Dunstable, and Ted Stark 114 to Salisbury, trying for Lasham. Charles Green and Ted Shephard declared for Old Sarum, 113 miles, and got there.

A day fit only for a spot-landing contest (winner Keith Aldridge, half an inch; runner-up, 2½ in.) was followed by a race from Davidstow to Perranporth which only Dr. H. N. Gregg, of the Coventry Club, completed by soaring along a sea breeze front in which he unexpectedly found himself.

After a couple of no-contest days the competition was wound up with Philip Wills in the lead with 364 points, Peter Scott close behind with 342, and Charles Green third with 264. But the weather on the following day, Whit-Monday, was the best ever, and Wills made his ninth attempt for 500 km. distance, falling short by only a few miles at Feltwell in Norfolk.

* * *

QUITE a few notable feats were performed in England while the World Championships were on in Germany. On Jne. 5, when cu-nims came to Butzweiler but no one was allowed to enter them, Pilot Officer Ian Strachan of the Fenland R.A.F. Club took an Olympia 2B into the base of a cu-nim near King's Lynn and got up to 15,000 ft. inside it before the lift dropped off.

He went in search of another, crossing the Wash to Boston and then proceeding to Wisbech, where a bigger and better cu-nim took him smoothly to 25,600 ft., when the oxygen gave out. Then, feeling thirsty, he reached out with his right arm through the canopy window on the left and broke off a piece of ice from the leading edge of the port wing.

On Jne. 18, Flt. Lt. Gordon Rondel, also of the Fenland Club, beat this with a climb to 30,100 ft. in the Olympia 2B. This, if confirmed, will be a U.K. height record.

From the London Gliding Club 4,672 miles of cross-country flying had been done this year up to the end of May, half of it in that month. A notable flight on May 31 was a triangular flight of 192 miles by Philip Jeffery via Lasham and Nympsfield, qualifying for Gold "C" distance and a Goal Diamond. He took 6½ hr.

Among many cross-countries since then was one by John Jeffries in a Kirby Cadet, the type with which the Air Training Corps used to do primary training. He flew it 133 miles from Dunstable to Cranwell via Stratford on Avon. On Jne. 26 Mike Fairman made Gold "C" distance to Plymouth solo in the Ka-7.

From Lasham on Sunday, Jne. 19, Mrs. Anne Burns beat her own feminine speed record for a 200-km. triangle with 32.6 m.p.h. Ron Willbie took 7 hr. over a 300-km. triangle via Colerne and Stratford on Avon. There were many other cross-countries, and as late as 19.45 the last pilot landed from the last thermal of the day.

Before Brian Jefferson left for Butzweiler to replace Lorne Welch in Nick Goodhart's crew, he had made his Gold "C" distance and earned a Diamond for a goal flight of 195 miles from Camphill to Exeter; and on the same day, May 28, Walter Neumark went 138 miles from Camphill to the Bristol Club's former site at Lulsgate in a Skylark 2.

Correspondence

Doors or Curtains?

THE article on pages 733 and 735 of your "Aircraft Furnishings" issue (THE AEROPLANE AND ASTRONAUTICS, Jne. 17), indicates that a great deal of thought has been given to the cabin furnishings of the Caravelle.

Three of the photographic illustrations show a hinged doorway between the two cabins. It is very apparent that the passengers occupying the rear pair of seats on the right side of the front cabin would have a tiresome flight. The door would either be wide open, closed, or opened at unexpected moments!

It is to be hoped that the operating carriers have substituted a curtain!

London, W.1. GP. CAPT. THOMAS F. U. LANG.

Information Wanted

I AM at the moment engaged in writing a history of Royal Air Force, Changi, and I would be most grateful if I could appeal to your readers for any information, however unimportant it may seem, that would help me in this task.

I am particularly lacking in information regarding the period 1939 to 1947. If anyone can be of any assistance, would they please contact me at the address below.

Officers Mess, M. R. NASH (Flt. Lt.).
R.A.F. Changi, Singapore 17.

A Noise Annoys

REGARDING H. A. Taylor's article "The Noise and the People" (THE AEROPLANE AND ASTRONAUTICS, Jne. 17), the opening of the second paragraph should surely be qualified by the words: "at any rate with present knowledge." In the late 1920s and early '30s retractable undercarts and V.P. airscrews were not considered practicable as the weight penalty would be unacceptable by the it-can't-be-done brigade in full cry.

The noise problem is very difficult and may take years to solve. So let it be alleviated by building two new London airports across Dungeness and Selsey Bill connected with London by two-mile-a-minute monorails. If Customs and other flap were done on the train during the 30-min. journey, passengers could get from A to B quicker than by using L.A.P. and Gatwick. And noisy airliners would take-off and land over the sea.

And by the time the new airports are ready we shall have VTOL airliners and another noise problem.

London, W.14. GEOFFREY DORMAN.

The Linnet's Fuel Cock

IN the above-titled letter (THE AEROPLANE AND ASTRONAUTICS, Jne. 10) is the phrase, "I would not like to fly an aeroplane which has no fuel cock" and this strikes me as being on a par with the conversation that took place between a newly-fledged officer and an erk. The former saw the latter doing a job at the front of an aeroplane and said: "What are you doing, my man?" To which the erk replied, "I'm polishing the propeller boss"; to which the officer replied, "Don't be impertinent—call me sir."

London, W.1. F. SMITH.

Veteran Viking

WITH reference to Mr. Dennis Powell's letter (THE AEROPLANE AND ASTRONAUTICS, Jne. 24) "Spotlight on B.E.A.'s Fleets," may I fill in a few facts about that veteran Viking G-AHOP, formerly B.E.A.'s RMA "Valerie."

Far from fading from the spotlight, this Viking was transferred to Airwork Services, Ltd., Experimental Division, and in June, 1959, made her début as a navigation and radio equipment demonstrator for the Marconi Wireless and Telegraph Co. Fitted with every type of latest navaid, including Doppler, she has flown to nearly every country in the Northern Hemisphere and at one time she was fitted with her own closed-circuit television.

So even after 8,344 flying hours G-AHOP is still claiming many "firsts" and no doubt will continue to do so for a number of years in her new guise.

Wimborne, Dorset. DAVID JONES.

Groundabout

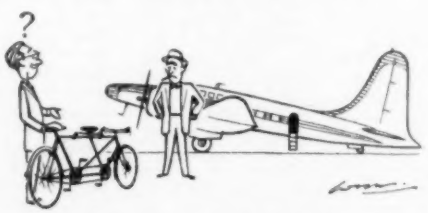
Submerger. R.N.A.S. Abbotsinch wanted an exhibit for their forthcoming Air Day display, so they wrote to Blackburn's for help. I'm told they got a reply expressing regret and explaining "Since Blackburn's merged with Hawker Siddeley, this aspect of our activity has been handled by de Havilland's."

*

Boggle Dept. Boeing statistics can be as baffling as they are impressive. In 19 months, 707s have carried, they say, five million passengers 100 million miles. My steaming slide-rule, which never lies, tells me that each passenger thus travels, on average, 20 miles. Or does it mean that the load factor is 5 per cent.? No wonder airline finances are shaky. And it's getting worse. The Boeing stats-men say that 707s are now daily carrying 25,000 passengers 400,000 miles, a drop from 20 to 16 mls./passgr. There's also the intriguing side-issue of how—and, indeed, why—all these people get *out* of the 707 after it's flown a mere 16 miles, leaving an empty, echoing cabin for the rest of the journey. A final dream-like statistic: "Boeing 707s have flown nine thousand million passenger-miles—this is equivalent to carrying the total population of Liverpool from London to Auckland, New Zealand." Apart from wondering how they'll all get from Liverpool to London, I bet that when they arrive at Auckland they'll find Leo White, N.Z.'s No. 1 photographer, taking a picture of every one of them.

*

Who, Me? Some people seem to think I'm doing well—I've been sent two lavish (American, of course) folders, each offering me a luxurious executive aircraft subject to a radical adjustment to my bank account. The first describes the "Landseaire Bonefish" which turns out to be an exotically modified Catalina amphibian with a canoe under each wing and a "deck lounge," this being the wings' top surface, railed off and fitted with chairs and tents. Actually, I couldn't even afford the folder. The other is a B-23 "Executive," the Douglas bomber-transport of 1940, about which the most appealing proposition is the phrase, "Will consider light twin trade-in."



Taken as Red. It happens in Holland, too. While practising left-hand circuits and bumps, a Dutch private pilot didn't notice that the circuit had been reversed. Flying control gave him a red flare but still he kept left. So they picked up the large "R" symbol and carried it to the grass strip he was using. Then he landed, taxied up and said genially: "You shouldn't have troubled—I did notice it was a *red* flare."

*

For the Record. I read that the Vickers Vanguard is "the first second generation propeller-turbine transport." The way the transport picture has swung jetwards, it may also be the last first second generation.

by Lorenz

Industry Record

Oxygen for Civil Operations

New requirements for the provision of emergency oxygen for passengers and crew in civil transports become mandatory in January of next year for both pressurized and unpressurized aircraft. Varying in detail according to the aircraft's performance and normal flight altitude, these latest Ministry of Aviation requirements are primarily designed for the protection of passengers as well as crew in the event of a pressurization failure in a pressurized transport.

In anticipation of these changes British Oxygen Aviation Services has, for some time, been studying the problems involved to enable operators to implement these requirements when they become mandatory. At its Harlow laboratories the company has paid particular attention to the development of lightweight and space saving liquid oxygen systems.

This has led to the introduction of B.O.A.S. Lox breathing systems which are now coming into service with the Fleet Air Arm and the R.A.F. A twin 25-litre Lox system has recently been ordered for the Short Britannic and a single 25-litre installation is to be fitted in the Armstrong-Whitworth 660.

In parallel with these developments in the application of liquid oxygen breathing systems in this country, B.O.A.S. now operates three-day instructional courses in its school at Harlow. Limited to about 15 students each, these courses are attended by experimental and development personnel from the aircraft industry and airline ground and air engineers.

Designed to familiarize these technicians in the use of liquid oxygen, they provide a comprehensive introduction to the operation and maintenance of Lox ground and airborne equipment. Starting from basic principles the syllabus includes lectures on the Lox system and its associated components, ground support equipment, and filling and handling procedures; laboratory demonstrations; and fault finding on a working test rig.

This installation, on the roof of its Radio Division factory, at New Southgate, is used by Standard Telephones and Cables for plotting polar diagrams of aerials on scale-model aircraft. The measurements are made using scaled-down aerials, operating at "scaled-up" frequencies, the results providing a very close approximation to actual operating conditions without the necessity for full-scale tests.

Helicopter Blade Broaching

The Lapointe Machine Tool Co., of Hudson, Massachusetts, whose associate company in this country is located at Watford, has developed a new type of broaching machine on the unit construction principle which enables it to be lengthened at any time to accommodate longer work pieces as required.

An example of this type of unit is a 64 ft. horizontal broaching machine recently installed at the Kaman Aircraft Corpn. for producing helicopter blades from hollow extrusions. Developed over a period of two years, it has a horizontal stroke of 340 in. and is powered by a 50 h.p. electro-mechanical drive which provides a steady pull on the drawbar during operation and also returns the drawbar to the initial position after each broaching pass.

Eight clamps hold the spar in position for broaching. Because of the length of the spar and the large amount of stock to be removed, over 30 separate passes are made to complete each part. Cutters are made of high-speed steel; they are designed as inserts and are mechanically fastened into toolholders.

All broaches are stored on a conveyor that carries them from one end of the machine to the other and tool changes are facilitated by two hoists. A hoist at the front end of the machine lifts a tool from the end of the conveyor and swings it into position in front of the drawbar. A hoist at the other end of the spar removes each broach after completion of the pass and deposits it on the conveyor.

In operation, a broach is taken by the hoist off the conveyor and attached to the drawbar, which is in position in the spar. The operator then presses the starter button and the broach begins to travel through the spar. During broaching, the operator travels to the other end of the spar on the moving platform.

When the operation is completed, he disengages the broach from the pull bar and, again using a hoist, positions it on the conveyor. As the pull bar returns through the spar and causes the conveyor to index, the operator and moving platform return to the initial position to start a new cycle.

The new horizontal broaching machine developed by The Lapointe Machine Tool Co., of Massachusetts. It has a 340 in. stroke and a moving platform for the operator.

Twenty-Fifth Anniversary

This year Ultra Electric (Holdings), Ltd., celebrates its 25th anniversary and to mark the occasion the company is organizing and sponsoring a programme of lectures. These are designed to be of use and interest to everyone connected in any way with the future of the electronics and associated industries and to promote general interest in the activities of the industry.

The first of these lectures will be given on Wednesday, Sept. 14, in the Recital Room of the Royal Festival Hall. The speaker will be Prof. Arthur Porter, Dean of Electrical Engineering at the University of Saskatchewan, whose subject will be "The Evolution of Instrumentation." On Oct. 19, also at the Royal Festival Hall, Mr. G. W. A. Dummer, Superintendent of Components Research, Development and Testing at the Royal Radar Establishment, will review the latest developments in components and the future in this field.

Steel Output Expansion

Under a new development scheme costing £32½ million, Appleby-Frodingham Steel Co., plans to increase its productive capacity for iron and steel and to install a new rod/bar mill; and Samuel Fox and Co., Ltd., is to add 100,000 tons per annum to its steel-making capacity. Both works are branches of the United Steel Companies, Ltd.

These major projects, which are scheduled for completion by the autumn of 1964, represent the largest development scheme ever to be undertaken by the company. When completed, together with other schemes already in hand, the ingot capacity of United Steel will be raised from its present level of about three million tons to about four million tons per annum.

At present, Appleby-Frodingham has a

Industry Record . . . .

planned annual productive capacity slightly exceeding one million tons of plates and sections. By the end of 1964, however, with the addition of the output from the rod/bar mill, this figure will approach 1,400,000 tons of finished products per annum. The decision to install a rod/bar mill with an additional capacity of 300,000 tons per annum has been taken in order to diversify the company's output of finished products and to extract the full potential from the existing primary iron and steel-making plant at its Scunthorpe works.

At Samuel Fox, redevelopment of existing steel melting and rolling capacity will permit output to be increased from its present level of 400,000 tons to 500,000 tons per annum. This will enable the company to meet the increasing demand for its alloy and stainless steels.

The first of a series of aircraft refuelling vehicles manufactured by Simmonds Aerocessories, Ltd., for Esso Petroleum to go into service at Barcelona, Madrid and Nicosia. It is capable of delivering 600 gal./min. to an aircraft from a ground hydrant.

Wind-finding Radar Order

Cossor Radar and Electronics are to supply C.R. 353 wind-finding radar to certain parts of New Zealand. The equipment, which is of the primary detection and tracking type, will be used to help form a network of radar weather stations in the South Pacific. There are to be eight installations: six on the New Zealand mainland, one at Nandi (Fiji) Airport and one on Funafuti Island.

In this system, an airborne balloon target, carrying an expendable reflector, is detected on an A-scope. Bearing and elevation are measured and indicated to an accuracy of 6 minutes. When definite location has been secured tracking can be maintained either by hand or automatically. The manual controls are basic, but the automatic tracking device is an extra, as are automatic print-out circuits and a data-converting computer.

An indicator and control unit is embodied in a desk unit with an aerial alignment indicator, aerial bearing and elevation indicators, the A-scope indicator and other basic controls. During the search phase of the wind-finding operation the A-scope is watched for the appearance of a target. When it is seen the bearing and elevation indicators are clamped and the machine is switched from "search" to "follow" thereby bringing the aerial motors under control. Automatic searching and locking of the range gate may be over-ridden by manual adjustment so that a correct target may be selected if more than one appear at the same bearing and elevation.

A data presentation unit, also a desk unit, holds the course and fine bearing and elevation indicator dials, the range indicator, the timing unit and a meter panel which accommodates two meters and associated controls for circuit monitoring. Further additions which can be incorporated include a data recorder for reading and recording (on paper tape) positional co-ordinates of the target, a teleprinter relay transmitter, and a height and ground range resolver which replaces the range and elevation display unit in the basic wind-finding apparatus.

Dutch Missile Blowers

Plannair, Ltd., are supplying the Dutch firm of electronic engineers, N.V. Hollandse Signaalapparaten, with axial-flow blowers for installation in both sea- and land-based missile launching systems now under development for the Dutch armed forces.

Three types of blower have been ordered, each with a specific application on missile launching sites. Printed circuit racks are to be cooled by 115-volt single-phase Plannair blowers, of which 450 have been ordered. The cooling of HF and LF apparatus will be undertaken by 50 220-volt three-phase blower units. A further 40 single-phase units of the 115 V H type will be used for demisting windows on firing control observation turrets.

Aviation Calendar

Jly. 8

Baginton, Coventry.—Lockheed International Aerobatic Competition and King's Cup Air Race, organized by the Royal Aero Club; and Jly. 9.

Cranfield.—The College of Aeronautics Presentation Ball in the Lanchester Hall, at the College, at 20.00 hrs.

Jly. 9

Biggin Hill.—Private aircraft Fly-In, arranged by Surrey Aviation, Ltd., and opening of the new Control Tower by the Rt. Hon. Miss Pat Hornsby-Smith, M.P., at 14.30 hrs.

Exeter.—Air Show.

Jly. 10

Elstree.—London School of Flying Rally, at Elstree Aerodrome. Time of arrival competition 13.30-14.15 hrs. Flying Display 15.00-16.30 hrs.

Jly. 15

Culdrose.—R.N. Air Station "Air Day," organized by the Fleet Air Arm.

Jly. 16

Odiham.—Inter Command R.A.F. Gliding and Soaring Association Gliding Week; until Jly. 23.

Brawdy.—R.N. Air Station "Air Day," organized by the Fleet Air Arm.

Jly. 17

Woburn Abbey.—Rally organized by the Royal Aero Club.

Jly. 21

London.—Third International Conference on Medical Electronics and Associated Scientific Exhibition, organized by the Electronics and Communication Section of the Institution of Electrical Engineers, at Olympia; until Jly. 27.

Jly. 23

Odiham.—Inter-Service Gliding week; until Aug. 1.

Lossiemouth.—R.N. Air Station "Air Day," organized by the Fleet Air Arm.

Jly. 24

Sutton Bank.—Gliding Week, organized by the Yorkshire Gliding Club.

Dunstable.—Gliding week, organized by the London Gliding Club.

Camphill.—Gliding week, organized by the Derby and Lancashire Gliding Club.

Jly. 30

Lasham.—Gliding week, organized by the Inter-Services Gliding Club; until Aug. 7.

Jly. 31

Mousatchevo, nr. Sofia.—World Parachuting Championships, organized by the Bulgarian Aero Club.

Company Notices

NEW COMPANIES

Totem Line (U.K.), Ltd. (661,684). Private co. Reg. Jne. 7. Cap. £100 in £1 shs. Aircraft brokers, carriers and commission agents. Sols.: Norton Rose and Co., E.C.3. Reg. off.: 30 Southampton Buildings, Chancery Lane, London, W.C.2.

Jet Charters, Ltd. (661,868). Private co. Reg. Jne. 9. Cap. £100 in £1 shs. To establish, maintain and operate lines of aerial communication. Directors: Malcolm MacDonald and Mrs. Sheila M. MacDonald, both of 24 Dunley Drive, Addington, Surrey. Sec.: Sheila M. MacDonald. Reg. off.: 5 Friends Road, Croydon, Surrey.

Metropolitan Air Movements, Ltd. (661,880). Private co. Reg. Jne. 9. Cap. £5,000 in £1 shs. Carriers or pilot of passengers, mails and goods by air. Sols.: Simmons and Simmons, 1 Threadneedle St., London, E.C.2.

Change of Name

Saunders-Roe (Anglesey), Ltd. (334,729). Fryars Works, Beaumaris, Anglesey. Name changed to Saro (Anglesey), Ltd., on Jan. 21, 1960.

New Patents

APPLICATIONS ACCEPTED

844,574.—**ACF Industries, Inc.**—"Instrument tilt simulator for non-flying aircraft trainer." Dec. 8, 1958.

844,847.—**English Electric Co., Ltd.**—"Fuel-system of aircraft."—Jan. 18, 1957. (Jan. 23, 1956.)

845,138.—**Koninklijke Nederlandse Vliegtuigenfabriek Fokker N.V.**—"Method for the manufacture of an aircraft part, and aircraft part made according to this method."—Jan. 28, 1958. (Feb. 20, 1957.)

844,748.—**English Electric Co., Ltd.**—"Aircraft wings incorporating a power installation for propulsion."—Jan. 4, 1957. (Jan. 11, 1956.)

845,144.—**Short Bros. and Harland, Ltd.**—"Guided missiles and the like."—Feb. 2, 1959. (Feb. 25, 1958.)

844,618.—**Folland Aircraft, Ltd.**, and **Davies, I. J.**—"Parachute harnesses."—Dec. 23, 1957. (Sept. 21, 1956.)

845,142.—**Short Bros. and Harland, Ltd.**—"Rocket-propelled aerodynes."—Feb. 2, 1959. (Feb. 25, 1958.)

844,614.—**Miles, Ltd., F. G., Miles, G. H.**, and **Brown, D. L.**—"Tandem-winged aircraft."—Nov. 5, 1957. (Aug. 15, 1956.)

Printed specifications of the above will be available on August 17, 1960, and the opposition period will expire on November 17, 1960.

Personal Notices

BIRTHS

Davis.—On Jne. 18, at R.A.F. Hospital, Cosford, to Margaret (*née* Bent), wife of Flt. Lt. Michael Davis—a son.

Edwards.—On Jne. 25, at St. Teresa's Hospital, Wimbledon, to Rosemary (*née* Tryson), wife of Sqn. Ldr. Martin Edwards—a son.

Hitchen.—On Jne. 22, at Cambridge Maternity Hospital, to Helen (*née* Worster), wife of Flt. Lt. L. J. Hitchen—a daughter.

DEATH

Hilton-James.—On Jne. 20, Gp. Capt. Charles Ernest Hilton-James, R.A.F. (Retd.).

Happy on the bottle for a 10 mile fall

Ejected at 55,000 ft. into air too thin for breathing. Bottled oxygen sees him through—British Oxygen. British Oxygen Aviation Services extend to the uppermost limits of the world. And on the ground to the ends of the earth.

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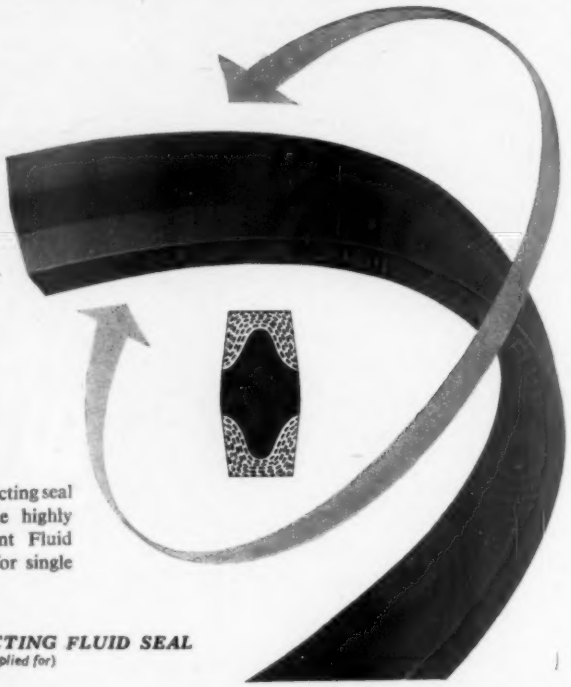

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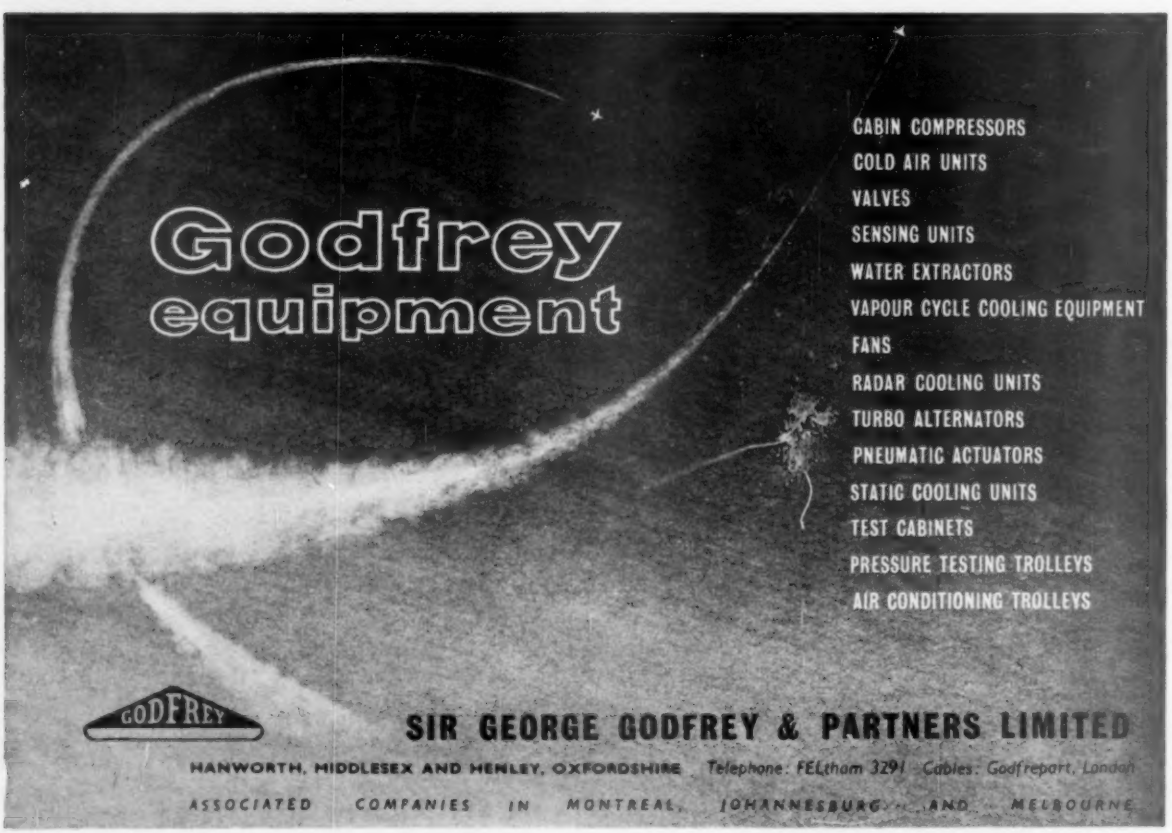

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PRESS DAY: Classified Advertisements must normally be received at Head Office by FIRST POST THURSDAY for the following Friday week's issue. Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

RATES—1/- per word (minimum 12 words 12/-). Each paragraph charged separately and name and address must be paid for. Semi-displayed setting £3-17-6 per single column inch. Centred lines 22/6. Series discounts of 5% for 13, 10% for 26 and 15% for 52 consecutive insertions, allowed to trade advertisers.

TERMS—Strictly net and prepayable. Monthly accounts for settlement by the end of the month following insertion are allowed to trade advertisers if satisfactory references are provided.

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THE PROPRIETORS retain the right to refuse or withdraw advertisements at their discretion and are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

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BRANCH OFFICES: Bayliss House, Hurst Street, Birmingham, 5. Telephone: Midland 6616. 50 Hertford Street, Coventry. Telephone: Coventry 27414. 1 Brazennose Street, Manchester. Telephone: Deansgate 6114–8. 12 Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

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CESSNA 195. We can now offer for fairly quick delivery one of these most attractive aircraft with only 1,832 hours since new and only 140 hours since complete overhaul of the engine. 195 is a fast 5-seater high wing monoplane with conventional Cessna undercarriage and powered by a 330 h.p. Jacobs engine. This aircraft is fully equipped with all the normal American aircraft extras.

CESSNA 210. We have one Cessna 210 immediately available. This aeroplane has been used exclusively as a factory demonstrator and has flown only 150 hours. It is the latest type with retractable undercarriage and all modern refinements, and is well set up with radio. It is at present fully imported and British registered.

CESSNA 182A. We have available a well-maintained 182A (Continental O-470 engine) with a total of 510 hours since new on both airframe and engine. The aircraft has been very well maintained and carries several extras including long range tank. It is equipped with VHF, Omni and ADF.

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL.

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM EAGLE AIRWAYS, LTD., OF 40 EDGWARE ROAD, LONDON, W.2:—

APPLICATION NO. 3656 for a Normal Scheduled Service with Viscount and DC6C aircraft, for the carriage of passengers, supplementary freight and mail between London Airport and Faro, at a frequency of three return flights weekly increasing later to one return flight daily initially from April to October each year, for 10 years from 1961.

FROM NORTH-SOUTH AIRLINES, LTD., OF LEEDS/BRADFORD AIRPORT, YEADON, NR. LEEDS, for the following U.K. Internal Services with Heron and Bristol 170 aircraft, for the carriage of passengers, supplementary freight and mail, at a frequency in accordance with traffic demand on each service, for seven years from July 1, 1960:—

APPLICATION NO. 3695 on the route Leeds/Bradford-Leavesden-London (Gatwick).

APPLICATION NO. 3696 on the route London (Gatwick)-Leavesden-Sandown (Isle of Wight).

FROM STARWAYS, LTD., OF LIVERPOOL AIRPORT, LIVERPOOL, 24, for the following Normal Scheduled Services for the carriage of passengers, supplementary freight and mail, for seven years from the dates shown:—

APPLICATION NO. 3737 with Dakota and DC4 aircraft, between Liverpool and Luxembourg at an initial frequency of four return flights monthly, increasing later in accordance with traffic demand, from January, 1961.

APPLICATION NO. 3738 with DC-4 aircraft, on the route Glasgow (Renfrew) and/or Liverpool and/or London-Laurenco Marques, at a frequency of four return flights monthly from October, 1960.

FROM DERBY AVIATION, LTD., OF DERBY AIRPORT, BURNASTON, DERBY:—

APPLICATION NO. 2373/2 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate on the route Swansea and/or Cardiff and/or Bristol-Ostend (opt.)-Luxembourg without Ostend-Luxembourg traffic rights, so as now to enable them to exercise traffic rights between those two points.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 542-13

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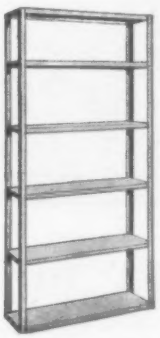

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INDEX TO ADVERTISERS

Name	Page
A	
Aero-Enterprises (Boreham Wood), Ltd.	31
Aircraft Materials, Ltd.	15
Airscrew Co. & Jicwood, Ltd.	10
Airwork, Ltd.	34
Allison Engines	Inside Back Cover
Associated Electrical Industries, Ltd.	9
B	
B.P. Aviation Services	23
British Oxygen Aviation Services	29
British Refrasil Co., Ltd., The	7
British Timken: A Division of The Timken Roller Bearing Co.	Inside Front Cover
Britool	14
B.S.T. Aeronautical, Ltd.	33
C	
Cadmium Nickel Batteries, Ltd.	22
Canadair, Ltd.	24
Cellon, Ltd.	Front Cover
Cross Manufacturing Co. (1938), Ltd.	33, 34
D	
Damic Controls, Ltd.	14
E	
Eagle Aircraft Services, Ltd.	4
Elliott Bros. (London), Ltd.	6
English Electric Co., Ltd., The, (Guided Weapons Division)	25
F	
Field Aircraft Services, Ltd.	13
Firestone Tyre & Rubber Co., Ltd.	27
Firth, Thos., & John Brown Ltd.	1
Flight Refuelling, Ltd.	20
G	
Godfrey, Sir George, & Partners, Ltd.	30
H	
Hall & Hall, Ltd.	30
Handley Page, Ltd.	33
Hawker Siddeley Aviation, Ltd. 2, 21, Back Cover	
Honeywell Controls, Ltd.	5
Hunting Aircraft, Ltd.	17
K	
Keegan, T. D., Ltd.	32
L	
Lockheed Precision Products, Ltd.	28
M	
Maitland Drewery Aviation, Ltd.	32
Ministry of Aviation	33
Mole, Group Captain Edward	31
Munro, R. W., Ltd.	12
R	
Rochdale Metal Products	33
Rolls-Royce, Ltd.	16
Rumbold, L. A., & Co., Ltd.	8
Rye, Claude, Bearings	33
S	
Sangamo Weston, Ltd.	14
Saunders Valve Co., Ltd.	10
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Silent Gliss, Ltd.	12
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S.P.E. Co., Ltd.	12
T	
Teddington Aircraft Controls, Ltd.	6
U	
Ultra Electronics, Ltd.	3
V	
Vickers-Armstrongs (Aircraft), Ltd.	18, 19
Vigors Aviation, Ltd.	31
W	
Walter's Electrical Manufacturing Co., Ltd.	8
Ward, Brooke & Co., Ltd.	8

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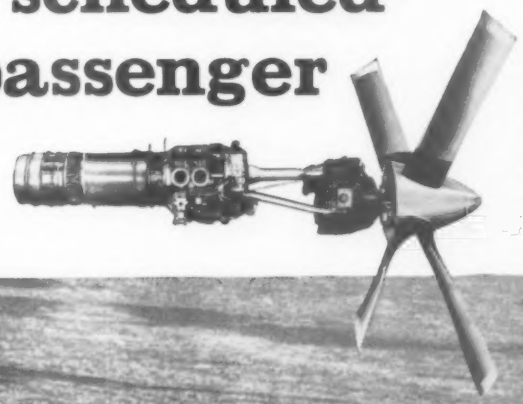

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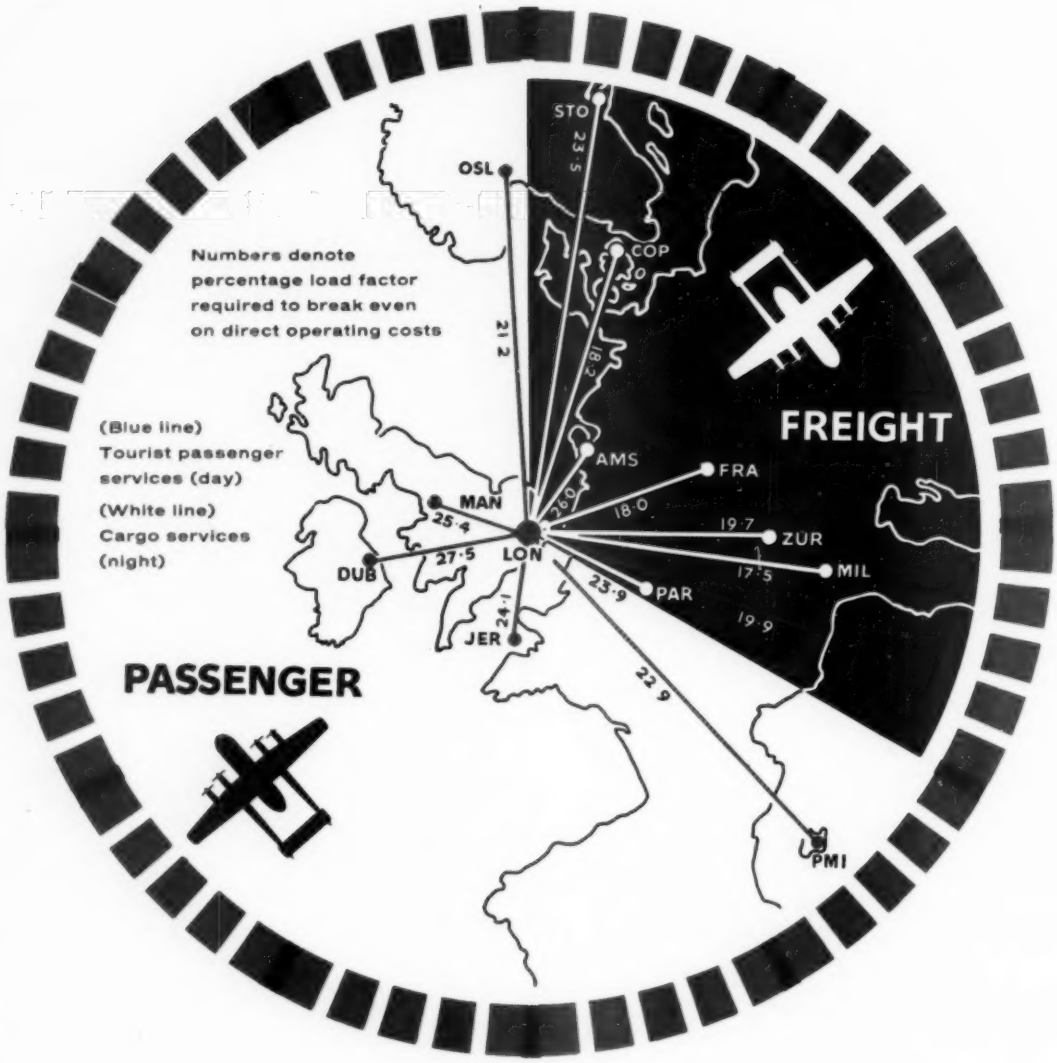

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